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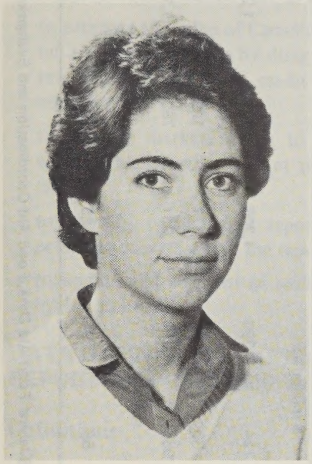
CANADA'S AGRICULTURAL TRADE WITH DEVELOPING COUNTRIES: AN ANALYSIS OF THE PAST LEVEL OF EXPORTS



The level of Canadian agricultural exports to developing and East European countries has risen significantly in the past decade. This article describes the composition of exports to these markets – food aid, credit and commercial sales – and provides estimated values of agricultural exports on a commercial basis. Several countries are identified as potentially important outlets for agricultural exports, based on trends in the 1969-78 period.

*Diana Wisner**

INTRODUCTION

The pattern of Canadian agricultural exports has changed in the past decade. Traditional markets, such as the EEC and the United States, have been declining in relative importance while the export level to developing countries has been increasing fairly consistently. The EEC's share of total Canadian agricultural exports fell from 34 percent in 1969 to 19 percent in 1978. Similarly, exports to the United States have declined from 24 percent of total agricultural exports in 1969 to 16 percent in 1978. Since 1973, exports to Japan, which comprised about 12 percent of total agricultural exports during the late sixties and early seventies have risen to 18 percent. At the same time, the developing countries' share of total agricultural exports has increased from 24 percent in 1969 to 32 percent in 1978. That of East European countries (including the U.S.S.R.) has increased from 1 to 12 percent. These trends in Canadian exports are summarized in Table 1.

If these trends continue, future opportunities for export expansion may lie in these latter regions. This is a particularly opportune time to examine the export potential in these developing and East European countries because of several factors recently discussed by J.S. Lohoar.[1] Of particular importance is the competitive edge enjoyed by Canadian exporters since the devaluation of the Canadian dollar in 1976, and the new export potential created with the successful conclusion of the Tokyo Round of Multilateral Trade Negotiations within the General Agreement on Tariffs and Trade.

Canadian agricultural products are presently exported to developing countries as food aid, on special credit terms and on a commercial basis. The complexity of this trade, summarized in Table 2, makes it difficult to assess the real commercial significance of markets in developing countries. This paper attempts to evaluate the relative importance of purely commercial sales, by disaggregating total trade into its various components. The analysis of trends in Canada's agricultural exports to developing countries during the 10-year period 1969-78 is one of several important factors which may be useful in identifying future market potential. Other factors reflecting opportunities for expansion of agricultural exports are the Balance of Payments situations

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[1] J.S. Lohoar, "Canada's Agricultural Trade – Recent Developments and Export Prospects," *Canadian Farm Economics*, Volume 13, No. 4, August, 1978.

TABLE 1. VALUE AND SHARE OF CANADIAN AGRICULTURAL EXPORTS BY REGION, 1969-78

Total Agricultural Exports to:	1969		1970		1971		1972		1973		1974		1975		1976		1977		1978	
	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %	Value $ mil.	Share %
All Countries	1,210	100	1,684	100	1,993	100	2,135	100	3,004	100	3,860	100	3,989	100	3,994	100	4,265	100	4,830	100
EEC (9)	407	34	511	30	632	32	568	27	705	23	942	24	844	21	901	23	908	21	925	19
U.S.	293	24	344	20	332	17	362	17	549	18	530	14	490	12	574	14	695	16	790	16
Japan	147	12	193	11	232	12	275	13	539	18	686	18	740	19	779	19	757	18	833	17
Eastern Europe	16	1	115	7	147	7	322	15	364	12	131	3	543	14	677	17	462	11	566	12
Developing Countries	289	24	444	26	568	28	535	25	724	24	1,396	36	1,208	30	922	23	1,289	30	1,536	32
Other	58	5	77	6	82	4	73	3	123	5	175	5	164	4	141	4	154	4	180	4

Source: *Trade of Canada – Exports by Countries,* External Trade Division, Statistics Canada.

TABLE 2. VALUE OF CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES, 1969-78

Type of Exports	Value of Exports									
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	$ million									
Total Agricultural Exports to Developing Countries	289	444	568	535	724	1,396	1,208	922	1,288	1,536
Total Food Aid to Developing Countries	63	68	65	63	89	124	177	169	175	161
Estimated Commercial Sales	226	376	503	472	635	1,272	1,031	753	1,113	1,375
	percent									
Commercial Sales as a Percentage of Total Agricultural Exports	78	85	89	88	88	91	85	92	86	90

Sources: *Trade of Canada – Exports by Countries,* External Trade Division, Statistics Canada; Annual Bilateral Food Aid Data, Food Aid Coordination and Evaluation Division, CIDA; Annual Multilateral Food Aid Data, International Liaison Service, Agriculture Canada.

of countries under consideration, their local agricultural production capacity, changes in consumption patterns and demand, etc. These, however, are beyond the scope of this paper.

The objectives of this study are as follows:

- to estimate the value of Canadian agricultural exports on a commercial basis by disaggregating total figures into food aid donations, credit and commercial sales components;
- to classify markets so as to create a framework within which further market research can be undertaken;
- to identify problems in reporting related data to permit improvements in the reporting method and
- to update and augment an earlier unpublished study by J.S. Lohoar.[2]

DATA DEFINITIONS, SOURCES AND REPORTING PROBLEMS

Definitions

Canada's agricultural exports to developing countries can be classified as follows:

Food Aid

Under the bilateral food aid program, agricultural products – the most important being wheat and wheat flour – are donated under country-to-country agreements. In the fiscal year 1977-78, food aid valued at $130 million was supplied under the bilateral program. Food aid is also provided multilaterally under the United Nations (UN) Food and Agriculture Organization (FAO) World Food Program (WFP). In the fiscal year 1977-78, Canada contributed agricultural commodities valued at $78 million to the WFP. Food aid is also provided multilaterally through the United Nations Works and Relief Agency (UNWRA) for Palestinian refugees.

Credit Sales

These involve grains exported to developing and East European countries on special credit terms, financed through the Canadian Wheat Board. "These credit facilities have been used to gain entry to markets for which there is commercial potential but which had been closed to Canadian grain sales because of more competitive credit terms offered by other exporters."[3]

Commercial Sales

These are agricultural products exported on normal commercial terms.

In reporting trade data, Statistics Canada does not distinguish among aid, credit and commercial exports. Hence it is impossible to directly evaluate Canada's commercial sales to developing countries, and the need arises to fill this information gap to facilitate market research and development.

Sources

The data used as a basis for this study were obtained from the following sources:

- External Trade Division, Statistics Canada, provided aggregate trade figures, without distinction between the various kinds of transactions described above.
- The International Liaison Service, Agriculture Canada, provided multilateral aid figures from the UN/FAO WFP.
- The Food Aid Coordination and Evaluation Centre, Canadian International Development Agency (CIDA), provided bilateral aid figures.
- The Cereal Grains Division, Grain Marketing Office, Industry, Trade and Commerce, provided credit sales figures.

Problems in Reporting Data

Several problems stemed from the fact that statistics were reported by different agencies, making comparisons among various sets of data difficult. Each source reported data for different periods. Total trade and multilateral aid figures are available on a calendar year basis, whereas bilateral aid figures are on a fiscal year basis and grain credit sales figures are on a crop year basis. Different accounting methods added another inconsistency to the data. For the years prior to the fiscal year 1977-78, CIDA included transportation costs in the value of bilateral food aid shipments, while the other sources reported values net of transportation costs.

In creating a data base containing time series of quantities and values for each commodity shipped under bilateral aid, multilateral aid or credit sales programs,

[2] J.S. Lohoar, *Markets for Canadian Agricultural Exports in Developing Countries,* unpublished paper, Agriculture Canada.

[3] ibid.

certain adjustments had to be made to allow comparison among the various figures.[4]

ESTIMATION OF COMMERCIAL SALES AND CLASSIFICATION OF COUNTRIES

Estimation

Estimates of commercial exports to each country were derived by subtracting total values of bilateral and multilateral food aid shipments from the values of total agricultural exports to that country. Since the amount of aid shipments tends to fluctuate substantially from year to year, and in order to minimize possible distortions caused by the fiscal-to-calendar year transformations, three-year averages of total agricultural exports and food aid figures were taken.[5]

Table 3 summarizes Canada's trade with developing countries by major commodity grouping, disaggregated into food aid and commercial exports.

Classification

To facilitate further research on future potential markets, the countries under consideration were classified according to geography and type of market.[6]

Geography

The breakdown was chosen to coincide as closely as possible with Statistics Canada's geographical breakdown and its definition of developing countries.

Type of Market

Commercial Markets – A combination of four criteria was used to identify a country having the potential for future expansion of commercial exports:

– an increase in the proportion of commercial sales relative to total agricultural exports between the two three-year periods, 1969-71 and 1976-78 (i.e., a decline in the proportion of food aid);

– the share of commercial sales relative to total agricultural exports exceeding 50 percent;

– the value of total agricultural exports exceeding \$0.5 million and

– an increase in the value of total agricultural exports between the two periods, 1969-71 and 1976-78.

In some cases, one of the criteria was given more weight than the others in classifying a country as a commercial market, even if not all four criteria were satisfied. For example, Pakistan was identified as such even though the share of commercial sales relative to total agricultural exports for 1976-78 is 44 percent (i.e., less than 50 percent), because the share increased from 9 percent in 1969-71. Thus Pakistan is evolving from a major food-aid recipient to one of the larger Asian commercial importers.

Exceptions were also made for OPEC countries such as Bahrain, the United Arab Emirates, Kuwait and Qatar, whose total agricultural imports from Canada are less than \$0.5 million. They were classified as commercial markets for two reasons. First, these countries are not aid recipients; therefore exports, however small, are entirely commercial. Second, these small, oil-rich countries have the highest average per capita incomes in the world. Their small populations combined with their enormous oil wealth resulted in 1976 per capita GNPs of \$15,480 in Kuwait, \$13,990 in the Emirates and \$11,400 in Qatar.[7] They are spending a large proportion of their foreign exchange earnings on food imports, as most of them have a limited productive capacity for agriculture.[8] These countries import a wide range of agricultural commodities from Canada, including grains, grain products, animal feeds, oilseed products, live animals, animal products and vegetables.

Credit Markets – Countries importing grains from Canada on special credit terms are included in this

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[4] For details regarding the manipulation of the data see Diana Wisner, "Canada's Trade with Developing Countries – Research Report," unpublished paper, Agriculture Canada.

[5] The two separate three-year periods are 1969-71, also covered by J.S. Lohoar, and 1976-78, the most recent for which data are available.

[6] Another interesting and useful classification, which might be taken into consideration when further detailed studies of potential commercial markets are undertaken, is that of the International Food Policy Research Institute (I.F.P.R.I.). The I.F.P.R.I. classification scheme groups the developing market economies by income based on average per capita 1973 GNP: middle income, US\$ 300 or more; and low income, less than US\$ 300. The Asian market economies are all in the low-income group.

[7] World Bank Atlas.

[8] USDA, "Changing World Agricultural Trade," Issue Briefing Paper, No. 7, September, 1978.

TABLE 3. TOTAL AGRICULTURAL EXPORTS, FOOD AID AND ESTIMATED COMMERCIAL SALES TO DEVELOPING COUNTRIES BY COMMODITY GROUPING[a]

Commodity	Total Exports to Developing Countries		Food Aid to Developing Countries		Commercial Sales[b]	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
			$ '000			
Wheat	296,912	789,299	49,151	85,575	247,761	703,724
Other Grains	9,424	63,708	728	2,298	8,696	61,410
Flour	49,285	126,721	8,838	39,559	40,447	87,162
Other Grain Products	6,920	8,498	–	–	6,920	8,498
Animal Feeds	1,997	3,552	–	–	1,997	3,552
Oilseeds	9,791	48,934	0	806	9,791	48,128
Oilseed Products	495	36,809	0	21,674	495	15,135
Live Animals	5,455	9,662	–	–	5,455	9,662
Meats	4,723	10,366	0	1,439	4,723	8,927
Other Animal Products	4,130	45,282	–	–	4,130	45,282
Milk Powder	21,404	42,868	1,902	12,350	19,502	30,518
Other Dairy Products	3,862	12,953	2,240	38	1,622	12,915
Poultry and Eggs	1,350	2,820	173	720	1,177	2,100
Fruits and Nuts	1,496	3,373	–	–	1,496	3,373
Vegetables (Excluding Potatoes)	4,622	12,391	195	310	4,427	12,081
Potatoes and Products	4,705	13,167	27	3	4,678	13,164
Seeds for Sowing	1,309	864	–	–	1,309	864
Other Agricultural	3,508	17,278	–	–	3,508	17,278

[a]Only countries considered as developing according to Agriculture Canada's definition are included here.

[b]Total exports less food aid (includes sales made on concessional or credit terms).

Sources: For total exports to developing countries, *Trade of Canada – Exports by Countries,* External Trade Division, Statistics Canada. For food aid to developing countries, Annual Bilateral Food Aid Data; Food Aid Coordination and Evaluation Division, CIDA and Annual Multilateral Food Aid Data, International Liaison Service, Agriculture Canada.

category.[9] The criterion for their selection was that the proportion of credit sales relative to estimated commercial sales was more than 30 percent for the three-year period 1976-78.

Food Aid – This category included the remaining developing countries, i.e., those not classified as commercial or credit markets.

Table 4 summarizes the results of the above analysis. Countries in the table have been grouped regionally and by type of market.

AN ANALYSIS OF COMMERCIAL MARKETS

The following countries, selected from the commercial markets, are the most important outlets for agricultural exports:[10]

- Central America: Cuba, Mexico, Trinidad-Tobago, Jamaica, Bahamas, Barbados and Bermuda;
- South America: Venezuela (OPEC), Colombia and Chile;
- Europe: East Germany, Romania, Czechoslovakia and Yugoslavia;
- Middle East: Iraq (OPEC), Iran (OPEC), Israel and Lebanon;
- Africa: Ghana, Morocco, Tunisia and Nigeria (OPEC) and
- Asia: India, South Korea, Philippines, Hong Kong, Taiwan, Singapore, Pakistan and Indonesia (OPEC).

Cuba is the largest developing country market in Latin America, with estimated commercial sales averaging $165 million in 1976-78, $120 million more than the next largest market, Mexico. The major commodities exported to Cuba are wheat flour (more than 50 percent of its total commercial agricultural exports from Canada), wheat, barley, oats, corn and other grains, milk powder, animal products (mainly tallow), potatoes and other vegetables (mainly dried beans).

Mexico's main imports from Canada are milk powder (59 percent of its total commercial agricultural imports from Canada), live animals, wheat and dairy products (other than milk powder).

Commercial exports to Jamaica and Trinidad-Tobago have increased significantly between the two periods 1969-71 and 1976-78, while exports to other Caribbean countries have risen little during the decade. Among the more important commodities exported to the Caribbean are meats, fruits and nuts, vegetables (including potatoes), wheat flour and other grain products, and animal feeds.

Venezuela is the most important South American developing country market, followed by Colombia. Major agricultural exports to Venezuela include potatoes and their products, wheat, vegetables, grain products other than wheat flour and meats. Colombia's main agricultural imports from Canada are grains other than wheat, especially barley; these constitute 86 percent of total agricultural imports from Canada.

In Eastern Europe, East Germany is by far the largest market; 1976-78 agricultural exports averaged $30 million, twice as much as the next largest market, Romania. The major commodities exported to these and other East European markets are wheat and other grains, live animals, raw cattle hides and other animal products.

The main agricultural commodities exported to major Middle East markets are as follows: wheat to Iraq and Lebanon (almost 90 percent of each country's total agricultural imports from Canada), barley, animal feeds and animal products, such as raw hides and tallow, to Iran and Israel.

Commercial agricultural exports to Ghana, Morocco, Tunisia and Nigeria, the largest developing country markets in Africa, consist mostly of wheat, and in the case of Nigeria, dairy products other than milk powder.

Among the Asian developing country markets, India and Pakistan share some characteristics. While food aid continues to be an important component of total agricultural exports, the share of commercial exports relative to the total has been increasing significantly. Estimated average sales on a commercial basis in 1976-78 are more than double the 1969-71 amount for India, and eight times the 1969-71 figure for Pakistan. Wheat is the most important agricultural commodity exported to Pakistan, and wheat, oilseeds and oilseed products are the major agricultural exports to India.

Agricultural exports to the other major Asian markets are varied. The most important are wheat, animal feeds,

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[9] Commodities other than grains, such as dairy products, for example, are also traded on credit terms, but the data for these transactions are not available. For these commodities, the values of credit sales are included in the estimated commercial sales values.

[10] Ranked according to the value of their agricultural imports from Canada, in decreasing order.

TABLE 4. CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES BY MARKET AND REGION

Market and Country	Total Canadian Agricultural Exports		Total Food Aid (Multi- and Bilateral)		Estimated Commercial Sales[a]		Concessional Sales	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
				$ '000				
COMMERCIAL MARKETS								
Central America								
Bahamas	4,918	5,190	—	—	4,918	5,190	—	—
Barbados	3,308	4,319	13	16	3,295	4,303	—	—
Bermuda	3,039	3,585	—	—	3,039	3,585	—	—
Costa Rica	414	630	0	1	414	629	—	—
Cuba	45,281	166,874	0	1,742	45,281	165,132	—	—
Dominican Republic	597	2,575	0	0	597	2,575	—	—
Guatemala	368	1,060	0	77	368	983	—	—
Jamaica	7,928	14,984	20	528	7,908	14,456	0	1,610
Leew.-Wind. Islands[b]	3,534	6,479	0	57	3,354	6,422	—	—
Mexico	11,339	26,481	274	1,778	11,065	24,703	—	—
Neth. Antilles	1,165	2,107	—	—	1,165	2,107	—	—
Nicaragua	491	1,075	0	33	491	1,042	—	—
Panama	542	1,237	—	—	542	1,237	—	—
Trinidad — Tobago	6,541	20,498	2	0	6,539	20,498	0	0
South America								
Argentina	630	3,770	—	—	630	3,770	—	—
Chile	1,068	5,407	37	0	1,031	5,407	—	—
Colombia	1,386	12,177	225	505	1,161	11,672	—	—
Ecuador (OPEC)	471	845	11	277	460	568	—	—
Surinam	173	750	2	0	171	750	—	—
Uruguay	469	1,609	—	—	469	1,609	—	—
Venezuela (OPEC)	7,716	12,938	0	0	7,716	12,938	—	—
Europe								
Malta	1,600	1,207	—	—	1,600	1,207	—	—
Portugal	1,955	6,826	0	3,119	1,955	3,707	—	—
Bulgaria	1,384	2,410	—	—	1,384	2,410	1,167	0
Czechoslovakia	3,216	11,743	—	—	3,216	11,743	0	0
East Germany	715	30,445	—	—	715	30,445	0	0
Hungary	1,255	3,190	—	—	1,255	3,190	1,098	0
Romania	2,177	15,361	0	0	2,177	15,361	—	—
Yugoslavia	1,396	9,142	—	—	1,396	9,142	400	0

continued

TABLE 4. (Continued) CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES BY MARKET AND REGION

Market and Country	Total Canadian Agricultural Exports		Total Food Aid (Multi- and Bilateral)		Estimated Commercial Sales[a]		Concessional Sales	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
				$ '000				
COMMERCIAL MARKETS (Continued)								
Middle East								
Bahrain (OPEC)	8	52	—	—	8	52	—	—
Cyprus	596	4,278	329	523	267	3,755	—	—
Emirates, United Arab (OPEC)	22	442	—	—	22	442	—	—
Ethiopia	14	3,879	0	1,525	14	2,354	—	—
Iran (OPEC)	1,850	20,344	0	0	1,850	20,344	—	—
Iraq (OPEC)	11,582	22,690	1,431	572	10,151	22,118	—	—
Israel	5,859	15,776	—	—	5,859	15,776	0	2,923
Jordan	84	2,153	88	647	0	1,506	—	—
Kuwait (OPEC)	65	218	—	—	65	218	—	—
Lebanon	1,076	16,489	13	901	1,063	15,558	—	—
Libya (OPEC)	560	1,498	—	—	560	1,498	—	—
Qatar (OPEC)	6	24	—	—	6	24	—	—
Saudi Arabia (OPEC)	1,641	2,197	—	—	1,641	2,197	—	—
Africa								
Ghana	5,108	16,087	1,900	2,396	3,208	13,691	—	—
Ivory Coast	38	515	0	40	38	475	—	—
Kenya	197	2,010	—	—	197	2,010	—	—
Mauritania	70	1,065	85	594	0	471	—	—
Morocco	3,369	10,983	1,160	690	2,209	10,293	—	—
Nigeria (OPEC)	1,138	3,031	577	0	561	3,031	—	—
Togo	337	631	0	0	337	631	—	—
Tunisia	3,108	5,807	2,721	2,599	387	3,208	128	0
Asia								
Hong Kong	4,228	18,977	—	—	4,228	18,977	—	—
India	48,180	69,104	31,425	29,237	16,755	39,867	—	—
Indonesia (OPEC)	2,228	8,377	1,746	3,131	482	5,246	—	—
Korea, North	2,408	3,156	—	—	2,408	3,156	1,787	0
Korea, South	4,018	40,830	624	7,860	3,394	32,970	—	—
Malaysia	1,128	2,723	43	0	1,085	2,723	—	—

continued

TABLE 4. (Continued) CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES BY MARKET AND REGION

Market and Country	Total Canadian Agricultural Exports		Total Food Aid (Multi- and Bilateral)		Estimated Commercial Sales[a]		Concessional Sales	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
				$ '000				
COMMERCIAL MARKETS (Continued)								
Pakistan	8,181	13,509	7,469	7,593	712	5,916	0	0
Philippines	6,388	22,304	29	191	6,359	22,113	5,072	0
Singapore	969	6,703	0	7	969	6,696	–	–
Taiwan	4,038	12,783	336	1,196	3,702	11,587	–	–
Thailand	442	3,045	0	103	442	2,942	–	–
CREDIT MARKETS								
Central America								
Haiti	2,783	10,062	0	303	2,783	9,759	1,702	3,178
South America								
Brazil	15,678	152,193	39	123	15,639	152,070	12,273	98,077
Peru	12,101	16,017	73	500	12,028	15,517	1,033	9,217
Europe								
Poland	9,167	127,739	–	–	9,167	127,739	8,217	85,780
Middle East								
Egyptian Arab Rep.	13,429	30,925	2,677	14,875	10,752	16,050	9,822	8,789
Syria	12,257	16,337	563	1,826	11,964	14,511	1,137	7,966
Africa								
Algeria (OPEC)	13,090	82,291	2,755	381	10,335	81,910	3,036	25,731
Asia								
China	144,799	269,270	–	–	0	0	148,281	320,707
Vietnam	454	11,227	355	9,330	99	1,897	0	2,100

continued

TABLE 4. (Continued) CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES BY MARKET AND REGION

Market and Country	Total Canadian Agricultural Exports		Total Food Aid (Multi- and Bilateral)		Estimated Commercial Sales[a]		Concessional Sales	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
				$'000				
FOOD AID								
Central America								
Belize	243	199	0	25	243	174	—	—
El Salvador	437	341	0	29	437	312	—	—
Honduras	269	667	12	179	257	488	—	—
South America								
Bolivia	32	182	69	202	0	0	—	—
Guyana	1,299	632	0	22	1,299	610	—	—
Paraguay	29	33	27	20	2	13	—	—
Middle East								
Somalia	31	1,968	31	2,248	0	0	—	—
Sudan	531	548	437	370	94	178	—	—
Turkey	3,348	625	2,091	39	1,257	586	—	—
Yemen	0	1,778	0	1,181	0	597	—	—
Africa								
Benin	161	109	0	8	161	101	—	—
Cameroon	138	54	52	25	86	29	—	—
Commonwealth Afr. Nes.[c]	10	88	1	623	9	0	—	—
French Africa Nes.[d]	607	459	310	829	297	0	—	—
Gabon (OPEC)	12	0	14	0	0	0	—	—
Guinea	115	53	72	60	43	0	—	—
Liberia	632	225	13	199	619	26	—	—
Madagascar	9	89	10	247	0	0	—	—
Malawi	146	61	0	63	146	0	—	—
Mauritius Dep.	48	73	39	67	9	6	—	—
Mozambique	294	3,033	0	1,897	294	1,136	—	—
Portuguese Afr. Nes.[e]	264	328	0	631	264	0	—	—

(continued)

TABLE 4. (Continued) CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES BY MARKET AND REGION

Market and Country	Total Canadian Agricultural Exports		Total Food Aid (Multi- and Bilateral)		Estimated Commercial Sales[a]		Concessional Sales	
	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average	1969-71 Average	1976-78 Average
				$ '000				
FOOD AID (Continued)								
Africa								
Senegal	182	1,097	112	1,349	70	0	–	–
Tanzania	169	4,135	0	3,731	169	404	–	–
The Gambia	125	213	2	362	123	0	–	–
Uganda	110	0	0	29	110	0	–	–
Zaire	224	810	0	896	224	0	–	–
Zambia	29	15	7	0	22	115	0	0
Asia								
Afghanistan	513	2,764	474	2,925	39	0	–	–
Burma	1,427	50	1,147	0	280	50	–	–
Khmer Rep.-Laos	0	12	0	0	0	12	–	–
Sri-Lanka[f]	2,844	8,534	2,174	11,046	670	0	–	–
Oceania								
Fiji	22	25	0	17	22	8	–	–

[a] Total agricultural exports less food aid (includes concessional sales) — three-year averages.
[b] Includes St. Kitts-Nevis and St.-Lucia Islands.
[c] Includes the following aid — recipient countries: Lesotho, Swaziland and Botswana.
[d] Includes the following aid — recipient countries: Mali, Upper Volta, Niger, Chad and the Central African Republic.
[e] Includes the following aid — recipient countries: Cape Verde Islands, Guinea-Bissau and Sao Tome.
[f] Includes the Maldives.

Sources: For total canadian agricultural exports, *Trade of Canada — Exports by Countries,* External Trade Division, Statistics Canada; for total food aid, Annual Bilateral Food Aid Data, Food Aid Coordination and Evaluation Division, CIDA, and Annual Multilateral Food Aid Data, International Liaison Service, Agriculture Canada and for concessional sales, concessional grains sales data, Cereal Grains Division, Grains Marketing Office, Industry, Trade and Commerce.

oilseeds, raw hides and other animal products, milk powder and other agricultural products such as infant foods and tobacco.[11]

SUMMARY AND CONCLUSIONS

To fill the gap in information regarding various types of trade with developing countries, a data base was created containing 13-year or longer time-series of quantities and values of shipments under the bilateral or multilateral food aid programs, or on credit terms, to individual recipient countries. Since it is now possible to retrieve data on any of the different transactions, for any country or commodity, in a form which enables comparison with Statistics Canada's figures of total agricultural exports, the task of assessing the actual commercial market potential of the countries under consideration is greatly facilitated.

In this paper the information now available has been used to update and extend the country-by-country analysis of total agricultural exports, food aid, credit and commercial sales contained in the earlier Lohoar study. Thus, within the framework of a geographical and market type classification, countries which could become important outlets for Canadian commercial agricultural exports have been identified. Their selection is based solely on the analysis of past trends in imports of agricultural products from Canada. This is intended as a possible starting point for further research, including an analysis of other factors relevant to the determination of future agricultural export opportunities for Canada.

Because of the large number of countries considered, only the potential areas of export expansion could be noted. A much more detailed examination is required of general economic indicators, as well as of the importance of Canada's trade relative to that of its competitors, in the potential commercial market of each developing country.[12]

Even this relatively superficial analysis of agricultural exports revealed that within a single geographical region, significant differences exist between countries in the mixture of commodities they import. Thus one country, for example, may import only wheat, almost exclusively, while its neighbor imports a wide range of commodities from Canada. In this respect, countries which import a large variety of agricultural products from Canada, especially luxury items such as meats and cheese, are of particular interest.

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[11] For more details of the commodity breakdown of exports to these commercial markets see Diana Wisner, "Canada's Trade with Developing countries, – Research Report," unpublished paper, Agriculture Canada.

[12] Agriculture Canada has already conducted such a study for a group of eight Asian countries: Hong Kong, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand. Population, income, trade and food production figures, as well as past growth rates and forecasts for the future, were looked at to determine the potential of these markets. See Soe Lin, "Prospects for Expanding Canada's Agricultural Exports to East Asia," *Canadian Farm Economics*, Volume 14, No. 6, December, 1979.

STRUCTURAL ADJUSTMENT IN THE QUEBEC DAIRY FARM SECTOR, 1971-1976

Between 1971 and 1976 about 5,000 new operators entered the dairy farm business in Quebec. Approximately 18,000 operators left the business during this period. Thirty-one percent of the latter moved to other types of farming. Most of these depended for their income in 1976 on cattle or cropping operations (or both) and increased off-farm work. The remainder left farming entirely, either to retire or to seek another type of employment.

*F.L. Tung and D. McClatchy**

INTRODUCTION

Between 1971 and 1976 the number of census farms in Quebec reporting three or more dairy cows fell 30 percent, from approximately 39,500 to about 27,500. This indication of rapid structural change in Quebec's dairy farm sector is consistent with an observed 31-percent decline in the number of dairy producers registered with the Canadian Dairy Comission, from approximately 38,200 in 1971-72 to about 26,300 in 1976-77. Furthermore, data for more recent years suggest that dairy herd consolidation in the province continues unabated.

The above figures suggest a net decline of approximately 12,000 in the number of Quebec dairy farms during the five-year period. Further evidence points to some 6,000 newly established dairy farmers in the province during the same period. Thus we can conclude that there was a gross outflow of about 18,000 dairy farm operators; that is, approximately 45 percent of the dairy farm operators counted in the 1971 census had left the sector within the next five years.

Appreciation of the magnitude of such an exodus naturally raises questions about what happened to those who left. How many retired? How many sold their farms and took a job or started non-farm businesses? How many continued farming but switched into alternative (non-dairy) forms of agricultural production like beef cattle or crops? For all the above groups, how many improved their well-being and how many suffered as a result of the adjustment which they made?

While complete answers to all of the above questions are not obtainable, a recent development at Statistics Canada provides the possibility of obtaining partial answers to some of them. This is the *1971-76 Agriculture Census Match,* described in the appendix. This information source for the 1971-76 period and for Quebec was used to investigate the following areas:

- the general pattern of entry, growth, decline and exit of dairy farm operators by herd size group;

- in particular, the agricultural activities of ex-dairy farmers in 1976 (i.e., farmers who reported more than two dairy cows in 1971, but less than three in 1976).[1]

*F.L. Tung and D. McClatchy are economists in the Production Analysis Division of the Policy, Planning and Economics Branch. They acknowledge helpful suggestions received from B. Perkins, R. Cumming, J. Girt, R. Bollman and anonymous reviewers, while accepting full responsibility for any shortcomings.

[1] The authors plan to report the results of similar investigations for Ontario and for both provinces at a sub-provincial (provincial regions) level in subsequent papers.

TABLE 1. MOVEMENT OF FARM OPERATORS BETWEEN 1971 AND 1976 CENSUS YEARS BY DAIRY HERD SIZE, QUEBEC[a]

Classification of Farms in 1971	Total No. of Farms (1971)	Exits (not Farm Operators in 1976)	Classification of Farms in 1976: Non-Dairy Farms	3–17 Dairy Cows	18–47 Dairy Cows	48–92 Dairy Cows	93 & Over Dairy Cows	Total Dairy Farms	Total No. of Farms (1976)
Non-Dairy Farms	21,640	11,510	9,235	480	355	60	5	900	10,125
Dairy Farms									
3–17 Dairy Cows	15,320	5,975	3,705	3,450	2,145	40	—	5,635	9,345
18–47 Dairy Cows	22,380	5,865	1,830	775	12,435	1,455	25	14,690	16,515
48–92 Dairy Cows	1,745	470	100	10	290	805	70	1,170	1,280
93 + Dairy Cows	70	25	10	—[b]	5	10	25	40	40
Dairy Total	39,515	12,335	5,645	4,235	14,875	2,310	120	21,540	27,185
Total No. of Farms (1971)	61,155	23,845	14,880	4,715	15,230	2,370	125	22,440	37,310
		Entries (Not Farm Operators in 1971)	9,090	1,055	3,325	680	50	5,110	14,205
		Total No. of Farms (1976)	23,960	5,765	18,550	3,065	175	27,555	51,510

[a]Farms classified as institutional are excluded. Total farm operators may not be identical to number shown in census publications because of adjustments for confidentiality. Some small discrepancies exist in totals shown because of rounding.
[b]— denotes zero or less than three farm operators.

Source: Compiled from the 1971-76 *Agriculture Census Match* data, Statistics Canada.

OVERVIEW

The data in Table 1 highlight the adjustments in the Quebec farm sector between the 1971 and 1976 census years. Fewer farm operators entered the farm sector than exited from it during that period. As a result, the net reduction in the number of farm operators was nearly 10,000 (16 percent) during the five-year period.

According to these data, of the 61,155 census farmers in the province in 1971 (39,515 dairy farms plus 21,640 non-dairy farms), 23,845 exited. Thus 37,310 remained in 1976. When added to the 14,205 entries between 1971 and 1976, a total of 51,510 census farms (27,555 dairy farms plus 23,960 non-dairy farms) in 1976 results.[2]

Dairy farm operators accounted for about 65 percent of total farm operators in 1971, but this was reduced to 54 percent in 1976. This does not reflect a higher exit rate from farming among dairy farmers (in fact 11,510, or 53 percent of the non-dairy farm operators in 1971 had quit farming entirely by 1976). It does reflect a large number of dairy farmers switching to non-dairy types of farm operation (5,645 versus 900 adjustments in the opposite direction). It also reflects many more new farmers coming into non-dairy operations (9,090) than into dairy operations (5,110). However, in terms of farm operator numbers, dairying remains the most important farming enterprise in Quebec.

From a total of 39,515 dairy farm operators in 1971, 31 percent (12,335) left the farm business entirely; 14 percent (5,645) abandoned their dairy operation but continued farming; the remaining 55 percent (21,540) stayed in dairy production. Of the 12,335 dairy farm operators in 1971 who had stopped farming (at least on their own account) by 1976, only 12 percent (1,460) were over 64 years of age in 1971, and 28 percent (3,400) were over 59. This suggests that the great majority would have sought some other form of employment rather than retiring.

Structural change in the Quebec dairy farm sector has resulted in a gradual trend towards fewer dairy farms and larger herd sizes. In 1971, 39 percent of the dairy farms had a herd size of less than 17 cows and less than

[2]In this paper, dairy farm is any farm reporting more than two dairy cows (i.e., with a significant dairy enterprise), and does not necessarily imply major dependence on dairy production as a source of farm income.

TABLE 2. HISTORICAL PROBABILITIES OF VARIOUS TYPES OF ADJUSTMENT BY QUEBEC DAIRY FARM OPERATORS, BY HERD SIZE CLASS, BETWEEN 1971 AND 1976[a]

Probabilities	3–17 cows	18–47 cows	48+ cows	All dairy farms
1. Probability of Giving Up Dairy Enterprise in Next Five Years[b]	.63	.34	.33	.45
2. Probability of Giving Up Farming in Next Five Years[b]	.39	.26	.27	.31
3. Probability of Switching to Non-Dairy Farming in Next Five Years[b]	.24	.08	.06	.14
4. Probability of Moving to a Larger Herd Size Class in Next Five Years[b]	.14	.07	n.a.	n.a.
5. Probability of Moving to a Smaller Herd Size Class in Next Five Years[b]	n.a.	.03	.17	n.a.
6. Probability of having Moved from a Smaller Herd Size Class in Past Five Years[c]	n.a.	.12	.47	n.a.
7. Probability of having Moved from a Larger Herd Size Class in Past Five Years[c]	.14	.02	n.a.	n.a.
8. Probability of having Started Dairy Farming in Past Five Years[c]	.26	.20	.25	.22
9. Probability of having Switched from Non-Dairy to Dairy Farming in Past Five Years[c]	.08	.02	.02	.03
10. Probability of having Started Farming in Past Five Years[c]	.18	.18	.23	.19

[a]1=2+3; 8=9+10 for each herd size class.
[b]Basis – 1971 dairy farm numbers.
[c]Basis – 1976 dairy farm numbers.

Source: Table 1.

5 percent had a herd size of more than 47 cows. By 1976 the proportion in the former category had fallen to 21 percent and the proportion in the latter category had risen to 12 percent. It is not surprising to find that for a dairy farm operator in the "under 18-cow" class in 1971, the probabilities of full exit from farming within five years (0.39) and of switching to a non-dairy type of farming within five years (0.24) were both considerably higher than the corresponding probabilities for all 1971 dairy farmers (0.31 and 0.14 respectively, Table 2).

Given the above trend and the rather strong relationship between herd size and net dairy farm income, it is surprising to find that more than 1,000, or 21 percent, of new dairy farm operators had herds of less than 18 cows in 1976. By today's standards, and unless augmented by other income-providing activities, this is a very low resource base with which to embark on a farming career.

GENERAL PATTERNS OF ADJUSTMENT BY HERD SIZE GROUP

Table 2 provides a summary of adjustment probabilities observed between 1971 and 1976. In interpreting this table, it is useful to recall that in 1976 there were approximately 6,000 dairy farmers with fewer than 18 cows, about 19,000 with 18-47 cows and some 3,000 with more than 47.

Almost half the dairy farmers with more than 47 cows in 1976 had grown from having fewer than 48 cows five years earlier. Another quarter had only begun dairy farming within the past five years. Hence, much evidence of recent dynamism exists among the larger herd operations.

On the other hand, there is less tendency for smaller herds to grow. For example, of the farmers in the 18-47 herd size class in 1971, 56 percent were in a similar situation five years later.[3] Among the remainder, the

[3]There is a possibility, given the range between 18 and 47, of considerable hidden (within-size class) growth within this 56 percent, even though the average size of herd in this class rose only from 28 to 30 cows during this five-year period (since more than 2,000 herds moved up from the 3-17 cow range in 1971). However, a more detailed analysis using more class sizes and narrower class intervals still supports the statement that farms in the small size classes showed less tendency to expand their herds.

TABLE 3. RESOURCE USE PATTERN OF DAIRY FARMS IN QUEBEC BY DAIRY HERD SIZE, 1976

	3–17 Dairy Cows	18–47 Dairy Cows	48–92 Dairy Cows	93 & Over Dairy Cows
Farm Land (Acres)				
Improved	82	147	244	448
Unimproved	75	84	102	132
Total	157	231	347	580
Land Use Pattern (Acres)				
Crop Land (Total)	61	112	193	361
Forage Crops	48	88	152	281
Feed Grains	10	20	30	45
Other Crops	3	4	11	35
Fruits and Vegetables	–	–	1	1
Improved Pasture	17	32	47	79
Summer Fallow	1	1	1	4
Other Improved Land	2	3	3	3
Wood Land	55	62	73	92
Other Unimproved Land	20	23	30	40
Farm Labor				
Off-Farm Work (Days)	51	15	6	7
Hired Farm Labor (Weeks)	3	8	8	82
Livestock On Farms				
Total Cattle	24	53	98	191
Milking Cows	11	30	59	119
Steers	1	1	2	4
Bulls	1	1	1	2
Other Cattle	11	21	36	66
Pigs	11	18	23	29
Sheep	1	–	1	–
Chicken	85	118	196	886

Source: Compiled from the 1971-76 *Agriculture Census Match* data, Statistics Canada.

likelihood of having switched to another type of farming was just as high as that of having expanded the dairy operation to more than 47 cows, and the likelihood of having quit farming altogether was much higher than either of these other two alternatives.

In this context it is interesting to note that a Laval University survey of Quebec dairy farmer's intentions in the summer of 1972 indicated that almost 50 percent of those surveyed planned to increase their herd size (by an average of about 10 cows) within the next five years.[4] As the authors pointed out, however, these 1972 intentions could be expected to have been modified considerably by large changes in prices of milk, feeds, fuel and fertilizers which shortly followed.

Some important evidence relating to the number of farms which declined in size came out of the match data – evidence which is not peculiar to the dairy sector, nor to the use of herd size as a measure of farm business size. In the past, much attention has been focused on the phenomenon of farm growth but very little on the phenomenon of voluntary contraction in the size, scope or scale of a farm firm's operations. Yet a declining farm size is consistent with certain life-cycle theories of economic behavior. Later in life when an operator's family has grown up and left home his income needs may be less, his available family labor supply smaller, his own energy level reduced and his capacity to understand and adopt new techniques diminished. Such a situation provides little incentive for expansion. Hence it would be rational for an operator to choose to reduce the size of his operation. In fact nearly a fifth of the farmers with more than 47 cows in 1971 had contracted to a smaller herd size class by 1976. Among those with 18-46 cows in 1971, the number who contracted to less than 18 cows by 1976 was nearly half the number who expanded to more than 46 cows.

[4] See "Les intentions de changement et les strategies d'adaptation des producteurs laitiers," Report 3 of "Les modalités d'adaptation des fermes laitières au Québec au cours de la décennie 1970-1980," Départment d'Économie rurale, Université Laval, Decembre 1974.

TABLE 4. NUMBER AND DISTRIBUTION OF FORMER QUEBEC DAIRY FARMS, BY PRODUCT TYPE, 1976

Type of Farm in 1976[a]	Number of Cows in 1971 3–17	18–47	48–92	Total[b]
Number of Farms				
Cattle	1,445	600	20	2,065
Hogs	275	170	10	455
Poultry	125	55	–[e]	185
Wheat	25	20	–	45
Small Grains	400	395	40	835
Other Field Crops	205	35	–	240
Fruits & Vegetables	130	70	5	205
Other Specialty	75	50	5	130
Mixed Livestock	120	20	–	140
Mixed Field Crops	20	10	–	30
Other Mixed	50	20	–	70
No Type[c]	425	305	10	740
Total[d]	3,305	1,745	95	5,155
		percent		
Distributions				
Cattle	43.7	34.4	21.1	40.1
Hogs	8.3	9.7	10.5	8.8
Poultry	3.8	3.2	–	3.6
Wheat	0.8	1.1	–	0.9
Small Grains	12.1	22.6	42.1	16.2
Other Field Crops	6.2	2.0	–	4.7
Fruits & Vegetables	3.9	4.0	5.3	4.0
Other Specialty	2.3	2.9	5.3	2.5
Mixed Livestock	3.6	1.1	–	2.7
Mixed Field Crops	0.6	0.6	–	0.6
Other Mixed	1.5	1.1	–	1.4
No Type	12.9	17.5	10.6	14.4
Total	100.0	100.0	100.0	100.0

[a]Type of farm is based on the definition employed in the Agriculture Census for which a farm is defined as a cattle farm if more than 50 percent of the total value of product sold is from cattle.

[b]The herd size class "93+ cows" is included in the total, but excluded from separate consideration because of small numbers.

[c]Less than $5,000 gross farm sales.

[d]Four hundred and ninety farms which had more than two dairy cows in 1971 and one or two dairy cows in 1976 are excluded from this table.

[e]– denotes that the number of farms is zero or one or two.

Source: Compiled from the 1971-76 *Agriculture Census Match* data, Statistics Canada.

The most striking feature of the overall adjustment pattern is that 45 percent of the 1971 dairy farm operators were not dairy farming in 1976. Two-thirds of these were not farming at all. The next section examines more closely the third who switched to another type of farm operation.

ADJUSTMENTS TO NON-DAIRY FARMING ALTERNATIVES

Typically, the other agricultural alternatives open to a dairy farmer are limited by his location and the fixed and semi-fixed resources at his disposal. In many cases the availability of part-time, off-farm employment opportunities will also be an important factor. Table 3 gives an idea of the average resource endowment in 1976 on dairy farms in each of the herd size categories. There is much variation, however, from these averages on individual farms. For example, most dairy farms with more than 92 cows report no chickens even though the average has nearly 900, because of the existence of a few such farms with a large number of birds.

Between 1971 and 1976, 40 percent of the producers who left dairying moved to beef production – many more than to any other particular type of farming enterprise (Table 4). Some evidence suggests that a greater proportion of the smaller than of the larger dairy producers moved into cattle and other livestock enterprises. Surface evidence of this is strong, but there may be a hidden bias in these figures because of the farm type definition in question.

Various types of cropping enterprise (small grains, wheat, other field crops, mixed field crops and fruits and vegetables) collectively accounted for another 26 percent of those farmers who switched from dairying. Hog enterprises (9 percent), poultry enterprises (4 percent) and mixed livestock enterprises (3 percent) represented relatively much less important adjustment routes.

The average dairy producer choosing another type of farming slightly reduced his land base, and changed very little his crop acreage and cropping pattern (Table 5). On the other hand, acreage of improved pasture land was generally significantly reduced. A reduction in the hired labor component and an increase in the days of off-farm work reported by the operator point to a considerable reduction in the size of the farm's labor input, and an important increased dependance on off-farm earnings to supplement farm income.

The data in Table 6 help determine the extent to which the above general pattern is true for particular types of within-farming adjustment alternatives. They also help determine the extent to which the adjustment route chosen may have been related to the original resource use pattern (while dairying). For example, regardless of herd size, the dairy farmers who became cattle farmers reported more days of off-farm work, both before and after adjustment, than those who became small grain or hog producers. Similarly, the former group reduced its improved pasture acreage much less than the two latter groups did. The small grains group, as dairy farmers in 1971, had already a larger crop acreage than the other two groups. Even so they were able to increase their

TABLE 5. CHANGES IN AVERAGE LAND AND LABOR USES OF FORMER DAIRY FARMS, QUEBEC

	3–17 Cows		18–47 Cows		48–92 Cows		Total[a]	
	While Dairying	After Dairying	While Dairying	After Dairying	While Dairying	After Dairying	While Dairying	After Dairying
Total Farm Land (Acres)	163	161	222	194	340	262	187	175
Improved	86	79	137	113	253	196	107	93
Unimproved	77	82	85	81	87	67	80	82
Land Use Patterns								
Cropland	55	59	92	91	173	167	70	72
Wheat	–[b]	1	1	2	1	12	1	2
Oats, Barley, Mixed Grain, Rye	12	9	19	13	35	18	14	10
Peas and Beans	–	–	–	–	1	1	–	–
Grain Corn	1	1	3	5	17	38	2	3
Forage Crops	41	47	68	68	116	92	51	55
Flaxseed, Soybeans, etc.	–	–	–	–	–	–	–	–
Potatoes	1	1	–	1	1	–	1	1
Tobacco	–	–	–	–	–	–	–	–
Sugar Beets and Other	–	–	–	–	1	–	–	–
Other Field Crops	–	–	–	–	–	1	–	–
Fruits	–	–	–	–	–	–	–	–
Vegetables	–	1	1	2	–	4	1	1
Improved Pasture	25	16	38	19	64	26	30	17
Summer Fallow	1	1	1	1	8	–	1	1
Other Improved Land	5	3	5	3	8	2	5	3
Wood Land	57	61	61	58	56	36	59	60
Other Unimproved Land	20	22	23	23	31	31	22	22
Farm Labor Use								
Off Farm Work (Days)	56	66	30	57	9	35	47	62
Hired Labor (Weeks)	3	2	8	4	35	9	5	3

[a]The herd size class "93+ cows" is included in the total but excluded from separate consideration because of small numbers.
[b]– denotes zero or less than 0.5.

Source: Compiled from the 1971-76 *Agriculture Census Match* data, Statistics Canada.

grain acreage significantly, after moving out of dairy production. Larger dairy farmers (with more than 47 cows) who switched to a hog production specialty had substantial decreases in total farm acreage, forage acreage and hired labor and a substantial increase in days of off-farm work.

The agricultural census data do not permit adequate evaluation of whether the dairy farmers who swithced to another type of farming were better or worse off because of the adjustment. At first sight it may appear from Table 7, considering the greater increase in average farm sales by dairy farmers and the large increases in farm sales enjoyed by farmers adjusting in the opposite direction, that our focal group made the wrong decision. However, it is clear from Table 5 that a move out of dairy production also implies a reduction in certain farm costs (e.g., hired labor) and an increase in the time available for off-farm work and earnings. Thus it remains fully conceivable that the overall net income position of the average farmer increased (in real terms) after such an adjustment.

SUMMARY AND DISCUSSION

Between 1971 and 1976 about 18,000 census farm operators moved out of dairy production in Quebec. Less than 20 percent of these stopped farming altogether and were of retirement age. More than half probably sought some other form of non-farming, full-time employment, while 31 percent adjusted to other types of farming.

Of those who switched farming styles between 1971 and 1976, the majority depended (in 1976) on income from cattle and cropping operations and from increased off-farm work. The importance of hog operations and poultry operations as avenues of adjustment for dairy farmers was relatively minor. There was no evidence to suggest that a move out of dairy farming was often facilitated by an opportunity to expand the farmland base.

The following evidence points to a continuing rapid decline in the number of Quebec dairy farmers:

TABLE 6. CHANGES IN AVERAGE LAND AND LABOR USES ON DAIRY FARMS ADJUSTING TO CATTLE, SMALL GRAINS AND HOG FARMS BETWEEN 1971 AND 1976, QUEBEC

	Cattle Farm (1976)			Small Grain Farm (1976)			Hog Farm (1976)		
	Dairy Herd Size Class in 1971								
	3–17	18–47	48–92	3–17	18–47	48–92	3–17	18–47	48–92
1971									
Total Land (ac)	187	263	403	141	191	304	136	181	296
Improved Land (ac)	89	142	256	92	146	254	78	119	222
Cropland	55	89	164	64	107	190	52	82	149
– Grains	10	18	43	20	36	75	16	19	30
– Forage	44	70	122	43	70	109	35	61	118
– Other	1	1	–	1	1	6	1	2	1
Improved Pasture (ac)	28	44	67	23	34	53	21	31	66
Unimproved Land (ac)	98	121	147	49	45	50	58	62	74
Off-Farm Work (days)	68	39	25	55	21	6	45	23	3
Hired Labor (weeks)	3	7	25	3	8	36	2	7	35
1976									
Total Land (ac)	195	251	360	135	171	270	130	142	123
Improved Land (ac)	86	126	209	90	130	239	70	94	101
Cropland (ac)	59	89	153	81	119	222	56	78	60
– Grains	6	10	16	30	49	138	13	25	33
– Forage	52	79	137	49	69	82	41	52	27
– Other	1	–	–	2	1	2	2	1	–
Improved Pasture (ac)	24	33	51	8	9	17	10	14	38
Unimproved Land (ac)	109	125	151	45	41	31	60	48	22
Off-Farm Labor (days)	73	64	52	74	51	25	51	35	37
Hired Labor (weeks)	2	3	11	2	4	10	2	6	1

Source: Compiled from the 1971-76 *Agricultural Census Match* data, Statistics Canada.

TABLE 7. AVERAGE VALUE OF AGRICULTURAL PRODUCTS SOLD PER FARM FOR DIFFERENT GROUPS OF FARM IN QUEBEC, 1971 AND 1976

Farm Group	1971	1976
	current dollars	
Continuing Non-Dairy Farms (Non-Dairy Farms in Both Years)	13,040	17,798
Continuing Dairy Farms (Dairy Farms in Both Years)	10,320	24,679
New Dairy Farms	–	24,441
Non-Dairy Farms in 1971 and Dairy Farms in 1976	4,870	17,103
Dairy Farms in 1971 and Non-Dairy Farms in 1976	6,540	7,243
Average (All Farms)	7,000	18,664

Source: Compiled from the 1971-76 *Agricultural Census Match* data, Statistics Canada.

– a demand for milk which is almost stationary or at best only slowly rising;

– considerable potential for increased milk output per cow in Quebec, implying fewer cows in the future;

– the existence of much new and largely unadopted dairy farm technology;

– increasing education levels of farm operators, resulting in the capacity to successfully manage larger, more complex operations, and to thus raise their income;

– a decreasing willingness of farm operators and their families to be tied to the farm every day of the milking season, coupled with the perceived advantage of a larger labor force in allowing a spelled milking roster and

– larger and still-growing average herd sizes in other provinces and countries.

It is reasonable to anticipate that many more Quebec dairy farmers will be seeking alternatives to dairy

farming. Does the present analysis yield anything which would provide a basis for encouraging them to look at farming alternatives rather than non-farming alternatives? Do some types of farming alternative promise more than others?

This study gives no evidence about the success of those who left farming entirely. However, the numbers involved suggest that this will remain the major road of future adjustment. It seems that the main arguments for encouraging more "within-farming" adjustments in the future will spring from concerns about expanding agricultural production and preserving the family-farm nature of the industry, rather than from objective assessments of the alternative income opportunities for the individuals involved.

Accepting that "within-farming" adjustments will be regarded as desirable, which directions should they take? Is knowledge about the past any use in guiding future farm adjustment, designing adjustment assistance programs or in deciding whether adjustment should be accelerated in some regions of the province and decelerated in others?

At this point, caution is necessary in answering such questions. There is a question about the reliability of the data (see the appendix) and there is a need to probe further for variations in the historical pattern which can be attributed to factors like the operator's age and the farm's locality. The importance of the availability of part-time, off-farm employment needs closer attention. The federal and provincial government policy environment within which dairy farmers must operate has changed considerably since the early 1970s.

Thus from a policy point of view, the present study is essentially exploratory. It does, however, provide the basis for some tentative hypotheses and highlight specific crucial areas where information is lacking and further investigation would be justified. The following hypotheses are suggested:

Hypothesis One: Farmers switching out of dairy production should specialize.

Specialized farm operations of one type or another have been much more popular than mixed farm operations among farmers adjusting out of dairy production. This is consistant with a gradual general trend towards more specialized farms, with the adjusting dairy farmer's own experience (most dairy farms are relatively specialized) and probably with his level of managerial ability (most have operated rather small scale dairy enterprises).

Hypothesis Two: In most cases, adjusting farmers should choose an alternative which will make use of their existing knowledge and skills (and physical plant) rather than switching to a completely new mode of production.

While the options of beef cattle and various crops may largely reflect the physical and market environment pertaining to Quebec, it is also true that most dairy farmers already know plenty about cattle husbandry and cultivation and cropping. The great majority of these adjusting farmers are not among the innovators of the farming population (if they were, they would likely have a thriving dairy business and would not want to adjust) and should not be expected to be able to adapt successfully to a completely new style of farming. (In 1976, less than 20 percent of Quebec dairy farmers reported having hogs, and only about the same proportion had any hens or chickens.)

Hypothesis Three: In the absence of an opportunity to increase the farmland base (and thus fully use the existing labor force under a less labor-intensive type of farming like cow-calf or grain cropping) the existence of the opportunity for part-time off-farm work is an important factor determining the feasibility of moving out of dairy production while still farming.

Between 1971 and 1976, 38 percent of the dairy farmers with less than 18 cows who moved out of dairying stayed in farming. For those with 18-47 cows in 1971 the figure was only 24 percent. On the average, all groups adjusting from dairying to another type of farming showed a substantial involvement in off-farm work after adjustment (Tables 5 and 6). The smaller herd size class already had such an involvement before adjustment, and thus conceivably found it easier to increase this involvement and facilitate adjustment in this way.

Hypothesis Four: Farmers with mixed dairy operations are more likely to be able to adjust successfully out of dairy production while remaining in farming than are highly specialized dairy producers.

To some extent this is an alternative to hypothesis three, as the observation that a higher proportion of adjusting dairy farmers with small herds remained in farming can also support the latter hypothesis. This is due to the census data showing that the smaller dairy operations are more likely to be mixed farming operations. In other words, the dairy farmer with the smaller herd is more likely to already have other non-dairy farm enterprises on which he could build.

Further work will focus on testing such hypotheses, examining the extent to which the general patterns of historical adjustment observed here varied among individual regions in Quebec and among provinces, and evaluating and perhaps improving the quality of the data source.

APPENDIX

The Data Source

Statistics Canada's *1971-76 Census Match* is a linkage of information reported for individual farms in each of these two census years. The computer is programmed to read a farm operator's name in 1976 and make a linkage if it finds an identical or sufficiently similar name in 1971 in the same census division. Linkages can be made in error (e.g., when a son has exactly the same name as his father), and legitimate linkages can be missed (e.g., when a farmer writes his name as W. Smith one time and Bill Smith another).

The 1971-76 match has not been quality tested for errors. However, the procedures followed were similar to those used to generate the 1966-71 match, which has been subject to several quality checks.[1] On the basis of these tests one can anticipate that matching errors of both types may total about 10 percent of the linkages made, and to interpret the data accordingly. Errors of about 10 percent of all linkages imply potential errors among the group identified as exiting farmers at a significantly higher level than 10 percent, and potential errors among the group identified as entering farmers at a yet higher level. Thus conclusions about these two latter groups must be made with caution when these data are used.

Despite its deficiencies, however, the agriculture census match is a rich source of previously unavailable information about some of the dynamic features of long-term structural change in the Canadian farm industry.

As with the more traditionally available census information, confidentiality requirements prevent Statistics Canada's release of data on individual farms. Consequently, Statistics Canada prepared all the basic tabulations used in the study. Confidentiality preservation and the recognition of some errors in the matching procedure, are the reasons why, in the grouped data which were used for the descriptive analyses reported here, the number of farms in each group has been rounded to the nearest five.

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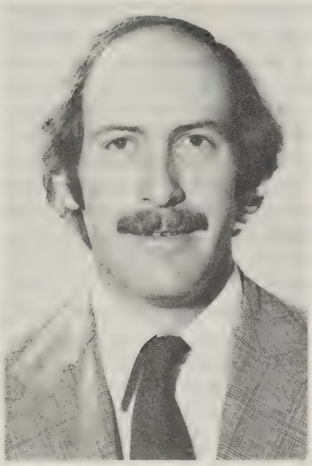
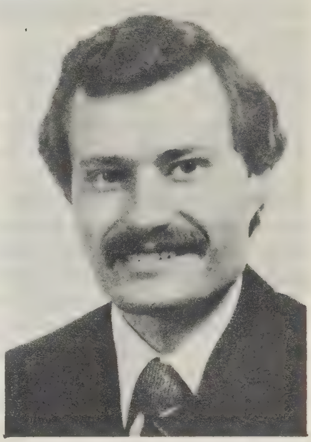
[1] For more details see: Bollman, R.D., *1966-71 Census of Agriculture Match: Methodology and Analysis of the Quality of the Match*, unpublished mimeograph, Agriculture Division, Statistics Canada, April 1977; and Falgon, C., *Pre-retirement Exit of Farm Operators: Conceptual Framework and Empirical Study*, unpublished Ph.D. thesis, Department of Agricultural Economics, Michigan State University, 1978, Chapter 4.

TERMS OF TRADE FOR AGRICULTURE



The price and quantity components of aggregate agricultural imports, exports and the balance of trade comprise the agricultural terms of trade and trade volume indices. The relationship between these aggregates is demonstrated for the 1968-78 period.



*Ralph Lattimore and Robert Danielson**

INTRODUCTION

The agricultural trade balance (the value of exports minus the value of imports) is a useful summary statistic. If it is positive it means that the agricultural sector is contributing to the overall trade balance for the entire economy. Agricultural trade, both exports and imports, is made up of price and quantity components. Consequently, when one is interested in examining the health of the agricultural sector in more detail it is useful to examine these two aspects of the trade balance separately. This article discusses the price component of the agricultural trade balance, which is often called the "terms of trade."

The terms of trade indicates the relative prices of exports to imports. It is measured here as the ratio of a Paasche index of export prices to an index of import prices. If the terms of trade rises, relative to a given base period, the implication is that it has become possible to buy more imports with the revenue earned from the sale of a given volume of exports. If export and import volumes remain unchanged, an increase in the terms of trade will be reflected in an improvement in the trade balance.

The agricultural terms of trade also measures the competitive position of Canada's food and agricultural sector against that of our trading partners and the extent to which policy intervention, at home and abroad, and other non-market forces are affecting exports and imports of farm products. The terms of trade has been calculated for this paper using prices expressed in Canadian dollars. This means that the terms of trade index will also fluctuate with the value of the dollar in addition to changes in world prices (expressed in foreign exchange).

AGRICULTURAL TERMS OF TRADE

In applying the terms of trade to the food and agricultural sector, it is necessary to make an assumption concerning the range of commodities to be included in the index. The definition employed here corresponds to that which Agriculture Canada has traditionally used. Agriculture commodities include all primary agricultural commodities (e.g., wheat, cattle, coffee beans and wool), all final consumer products of the food processing industries (e.g., butter, bread and refined sugar) and all intermediate products of the food processing sector (e.g., linseed oil, molasses and crude animal products). The total agricultural terms of trade, computed for the export and import prices of all these commodities, is shown in Figure 1 on a quarterly basis for the period 1968-78. The terms of trade is expressed as an index with 1971 set equal to one. The total agricultural terms of trade is also given numerically in the first column of Table 1.

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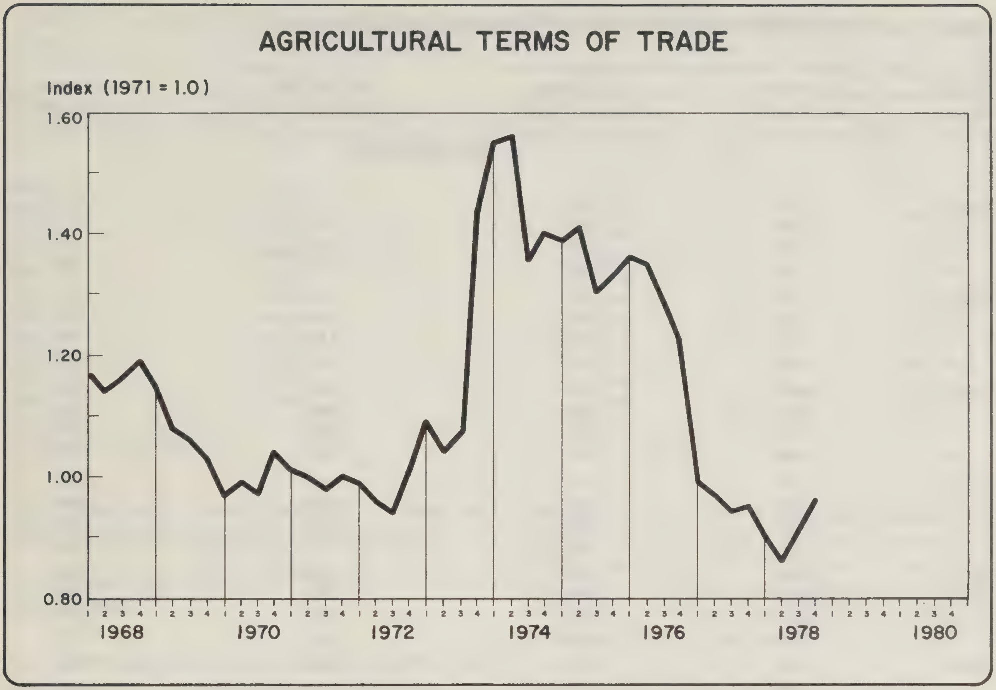

Figure 1

The first feature of the agricultural terms of trade is its variability. From the first quarter of 1968 to the second quarter of 1972, it deteriorated steadily, mirroring the slow decline in grain prices and the steady rise in import prices due to inflation. Then from the third quarter of 1972 to the first quarter of 1974, the sharp rise in grain prices improved the agricultural export prices relative to agricultural import prices. However, the extremely favorable position attained in 1973 was short-lived. In the third quarter of 1974, the agricultural terms of trade began to decrease and while there was a flattening out in the final quarters of 1974 and 1975, the index tended to decline through to the second quarter of 1978. The sources of this deterioration were extreme fluctuations in world agricultural commodity prices. The way in which these occurred reduced Canada's agricultural terms of trade. Also, the extent of the rise in the world prices of imported products was higher than indicated on the graph because the Canadian dollar was appreciating during this period.

In 1974 the price of imported raw sugar tripled and the price of imported dairy products increased more than 20 percent, while export prices of most commodities tended to stabilize at 1973 levels. This caused a sharp fall in the agricultural terms of trade in the third quarter of 1974 (Table 1). During 1975, fluctuations in export and import prices largely offset one another. Imported beef prices declined 35 percent, offsetting rising dairy and fruit and vegetable import prices. In the second quarter of 1976, the agricultural terms of trade again began to decrease. Major export prices (for grains and oilseeds) and import prices (for sugar) declined but export prices tended to decline faster. This effect was compounded by the 100-percent increase in coffee prices during 1976. The resulting deterioration in the 1976 index was mild compared with the shock that occurred in the first quarter of 1977. Coffee prices doubled again in 1977; tea prices increased more than 100 percent; and the prices of orange juice and imported soybeans increased 40 percent. Oilseed export prices did not compensate for the rise in soybean prices and the net result, with a continuing decline in grain prices, was that the index fell from 1.23 (1971=1.00) in the fourth quarter of 1976 to 0.99 in the first quarter of 1977. This decline was accentuated by the falling value of the Canadian dollar so that the terms of trade index reflected both the exchange rate effect and changing world commodity prices.

In the second quarter of 1978, the agricultural terms of trade began to improve. Export prices were increasing

TABLE 1. AGRICULTURAL TERMS OF TRADE, VARIOUS MEASURES, 1968-78

Year and Quarter	Ag. Exports/ Ag. Imports[a]	Ag. Exports/ Indigenous Imports[b]	Ag. Exports/ Non-Indigenous Imports[c]	Ag. Exports Non-Ag. Exports[d]
		Index 1971 = 100		
1968-1	1.17	1.16	1.18	1.12
2	1.14	1.15	1.14	1.11
3	1.16	1.17	1.14	1.11
4	1.19	1.19	1.19	1.09
1969-1	1.15	1.12	1.19	1.12
2	1.08	1.10	1.06	1.05
3	1.06	1.05	1.06	1.05
4	1.03	1.03	1.04	0.98
1970-1	0.97	0.98	0.96	0.97
2	0.99	1.02	0.95	0.98
3	0.97	0.99	0.95	0.97
4	1.04	1.06	1.02	0.99
1971-1	1.01	1.02	1.00	1.00
2	1.00	1.01	0.98	1.00
3	0.98	0.99	0.96	0.99
4	1.00	0.98	1.02	0.99
1972-1	0.99	0.99	1.00	1.01
2	0.96	0.99	0.93	0.99
3	0.94	0.97	0.91	0.99
4	1.01	1.02	1.00	1.07
1973-1	1.09	1.06	1.15	1.21
2	1.04	0.99	1.14	1.25
3	1.07	1.00	1.15	1.29
4	1.44	1.41	1.49	1.62
1974-1	1.55	1.49	1.66	1.69
2	1.56	1.63	1.45	1.68
3	1.36	1.47	1.21	1.54
4	1.40	1.54	1.23	1.58
1975-1	1.39	1.50	1.21	1.46
2	1.41	1.54	1.23	1.47
3	1.30	1.39	1.20	1.35
4	1.33	1.43	1.24	1.33
1976-1	1.36	1.36	1.34	1.27
2	1.35	1.43	1.21	1.25
3	1.29	1.39	1.14	1.21
4	1.23	1.26	1.19	1.17
1977-1	0.99	1.04	0.92	1.08
2	0.97	1.03	0.89	1.06
3	0.94	1.01	0.85	1.00
4	0.95	1.03	0.88	1.00
1978-1	0.90	0.94	0.85	1.01
2	0.86	0.88	0.84	0.99
3	0.91	0.95	0.86	1.02
4	0.96	1.00	0.92	1.06

[a]The index ratio of (food and) agricultural export prices to import prices.

[b]The index ratio of agricultural export prices to the import prices of indigenous (or domestic competing) products.

[c]The index ratio of agricultural export prices to import prices of non-indigenous products (i.e., non-competing) products.

[d]The index ratio of agricultural export prices to non-agricultural export prices.

Source: Agriculture Canada.

TABLE 2. VOLUME OF FOOD AND AGRICULTURAL EXPORTS AND IMPORTS, 1968-78

Year	Volume of Agricultural Exports (1)	Volume of Agricultural Imports (2)	Ratio of Ag. Export/ Ag. Import Volume Index (1)/(2)=(3)
	— 1971 dollars in millions	—	
1968	12.938	12.244	1.06
1969	11.657	13.375	0.87
1970	16.936	13.114	1.29
1971	19.492	12.964	1.50
1972	19.831	14.308	1.39
1973	18.337	15.753	1.16
1974	14.804	16.246	0.92
1975	16.072	16.216	0.99
1976	17.841	18.972	0.94
1977	21.276	17.565	1.21
1978	22.019	17.475	1.26

Source: Agriculture Canada.

slightly while major import prices (e.g., for sugar and coffee) decreased from those of the previous year.

ALTERNATIVE TERMS OF TRADE MEASURES

The agricultural terms of trade index for 1968-78 is shown in Table 1 with three other related indices. The second index is the agricultural terms of trade for prices of imported products which compete directly with domestic production, i.e., indigenous products.[1] Such imports include such commodities as soybeans, corn, apples and strawberries. The third index is expressed in terms of non-indigenous (or non-competing) imports. This group includes only products which one normally considers not to compete with domestic production. It includes tropical fruits, coffee, tea, natural rubber, cotton and raw cane sugar (even though beet sugar is produced domestically). These two indices, however, follow the same general pattern as the total agricultural terms of trade.

The fourth index in Table 1 is the ratio of agricultural to non-agricultural export prices. Again the general pattern is the same but with some interesting differences. Index No. 4 rises more sharply in 1973-74 and bottoms out at a higher level in 1978. At the end of the period, agricultural export prices have tended to perform well with respect to non-agricultural prices but have not kept up with agricultural import prices.

VOLUME OF AGRICULTURAL TRADE

Inferences about the agricultural balance of trade need to take the volume of trade into account as well as the prices of commodities traded. Indices of the volume of agricultural imports and exports are in Table 2. The volume of trade increased in favor of exports from 1969 to 1971-72. Thereafter it declined until 1976. This shows that during the later period the import volume tended to increase faster than the export volume. Since 1976, however, the agricultural export volume has again been increasing faster than the volume of agricultural imports.

CONCLUSION

The agricultural terms of trade and trade volume indices provide useful insights into the overall trade performance of the food and agricultural sector. They can serve to pinpoint changing Canadian consumer tastes and preferences, changing patterns of Canadian food and agricultural production, the influence of world agricultural commodity prices and during the longer term, trends in policy interventions affecting our trade.

[1] The distinction between indigenous and non-indigenous imports is always somewhat arbitrary and tends to be determined on the basis of general acceptance. For example, out of season, temperate climate fruits and vegetables are classified as indigenous products when they would perhaps be better described as non-indigenous products. Adjustments such as these may be made in the near future.

ECONOMIC INDICATORS

POLICY, PLANNING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1977		1978					1979		
		IV	Annual	I	II	III	IV	Annual	I	II	III
Production and Income											
1. GNP at Market Prices[a]	$ mil.	216,824[b]	209,379[b]	221,428[b]	228,052[b]	233,600[b]	238,548[b]	230,407[b]	248,784[b]	255,204[b]	264,400[c]
2. Farm Cash Receipts Total[d]	$ mil.	2,655.4[b]	10,090.8[b]	2,929.9[b]	2,727.0[b]	2,900.3[b]	3,341.6[b]	11,899.0[b]	3,354.9[b]	3,234.1[b]	3,431.3
3. – Total Crops[d]	$ mil.	1,092.8[b]	4,334.6[b]	1,470.7[b]	1,026.4[b]	1,161.0[b]	1,248.0[b]	4,906.1[b]	1,447.9[b]	1,182.4	1,486.6
4. – Total Livestock[d]	$ mil.	1,442.1[b]	5,263.3[b]	1,360.5[b]	1,612.0[b]	1,645.3[b]	1,923.7[b]	6,541.5[b]	1,830.9[b]	1,930.2[b]	1,843.2
5. Net Income Rec'd by Farm Operators[a]	$ mil.	2,712.0[b]	2,874.0[b]	3,020.0[b]	4,152.0[b]	3,252.0[b]	3,632.0[b]	3,514.0[b]	3,672.0[b]	4,204.0[b]	3,804.0
Trade											
6. Agricultural Exports	$ mil.	1,089.9[b]	4,265.4[b]	946.4	1,230.5	1,261.3[b]	1,391.8[b]	4,830.1[b]	1,204.4	1,354.7	1,663.9
7. Agricultural Imports	$ mil.	881.5[b]	3,556.1[b]	876.7[b]	1,088.5	943.2	1,104.4	4,012.7	1,129.2	1,181.6	1,129.4
8. Real Domestic Product, Ag[a]	1971=100	114.0[b]	108.6[b]	119.5[b]	114.3[b]	117.5[b]	119.7[b]	117.8[b]	115.1	115.7[b]	115.6
9. Real Dom. Prod., Less Ag[a]	1971=100	131.9[b]	130.9[b]	133.6	135.1[b]	136.6[b]	138.3[b]	135.9[b]	139.1	138.8[b]	140.8
Price Indexes											
10. Farm Input Price Index	1971=100	181.7	180.0	190.8	200.2	203.2	209.2	200.9	224.0	228.9[b]	229.8
11. – Buildings and Fencing	1971=100	190.0	183.9	193.5	197.6	203.1	209.9	201.0	216.1	223.2	229.5
12. – Machinery & Motor Veh.	1971=100	169.1	164.4[b]	172.6	174.0	176.0	182.1	176.2[b]	188.0	191.8[b]	196.1
13. – Crop Production	1971=100	216.1	213.7	217.9	225.5	228.3	230.2	225.5	238.6	252.5[b]	255.5
14. – Animal Production	1971=100	165.2	167.4	178.0	203.7	207.3	218.2	201.8	246.8	252.3[b]	247.7
15. – Hired Farm Labor	1971=100	213.0	208.6	214.5	217.9	223.9	225.4	220.4	228.0	232.8	235.7
16. – Interest	1971=100	244.8	244.8	284.5	284.5	284.5	284.5	284.5	310.6	310.6	310.6
17. Farm Prices of Ag. Prod[d]	1971=100	187.1	189.6	192.7	206.8	209.9	221.9	206.9	234.3	N.A.	N.A.

continued

POLICY, PLANNING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (concluded)

Item	Units or Base	1977		1978					1979		
		IV	Annual	I	II	III	IV	Annual	I	II	III
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	283.5	1,124.6	153.9	372.9	418.8	342.4	1,288.0	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	462.7[b]	464.0	458.0	462.3	479.3	490.3	473.0	498.3[b]	492.7[b]	466.7[b]
20. Av. Farm Labor Rates	$/hr.	3.66	3.58[b]	3.67	3.73	3.78	3.84	3.76	3.89	3.95	4.01
21. Av. Hourly Earnings-Manuf.	$/hr.	6.57	6.38	6.67	6.77	6.87	7.03	6.84	7.19[b]	7.37[b]	7.50
22. F.C.C. – Gross Loan Disburs.	$ mil.	125.4	508.8	78.4	127.8	205.7	121.7	533.6	35.4	174.7	192.4
23. CPI – All Items	1971=100	166.1	160.8	169.2	173.3	177.7	180.5	175.2	184.6	189.4	193.1
24. – Food at Home	1971=100	188.6	178.8	194.8	208.3	218.7	216.4	209.6	228.6[b]	237.9	241.6
25. – Food Away from Home	1971=100	190.0	187.0	192.6	194.9	202.2	207.3	199.3	213.1	220.8	227.3
26. Industry Selling Price Index – Food & Beverage	1971=100	189.2	185.9	195.1[b]	204.6[b]	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.1
Other Indicators											
27. Unemployment Rate	%	8.4	8.1	8.4	8.5[b]	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1
28. Exchange Rate	$ U.S.	1.10	1.06	1.11	1.13	1.14	1.18	1.14	1.19	1.16[b]	1.17
29. Av. Rate on New Demand Loans	%	8.68[b]	8.88[b]	8.70[b]	9.66[b]	10.03[b]	12.32	10.18	12.31	12.55	12.81
30. Quarterly Pop. Est.	mil.	23.34[b]	23.26[b]	23.39[b]	23.44[b]	23.50	23.55	23.48	23.60	23.64	23.69

[a]Seasonally adjusted at annual rates.
[b]Revised.
[c]Preliminary.
[d]Excludes Newfoundland.
[e]Excluding repair parts.
[f]N.A. = Not available.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Policy, Planning & Economics Branch, Marketing Analysis and Trade Policy Directorate; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the Bank of Canada Review.

NOTES

ASSISTANCE FOR THE CANADIAN POTATO INDUSTRY

Agriculture Canada will implement a series of federal initiatives to assist Canadian potato producers.

These include a program to improve the quality of Canadian seed potatoes; funds to help producer groups build or upgrade potato storages; a new insurance program to cover seed growers against production, storage, and marketing risks; further federal research to improve potato production and disease control; a market development program for seed potatoes and a stabilization payment to growers in Ontario, Quebec and the Atlantic Provinces for their 1978 crop.

The potato industry in eastern Canada has faced serious problems in the past few years from changes in traditional market patterns. These new initiatives will involve the federal government, the provincial governments and producers themselves in an overall plan to stabilize the industry, improve marketing, and increase grower returns.

Prices were inadequate for the 1978 crop in eastern Canada, particularly in the Maritimes. Growers are again receiving poor returns for 1979 potatoes and their problem is worse because of spoilage in storage.

Seed Quality Program

Agriculture Canada plans to undertake a seed quality improvement program in cooperation with the industry. A detailed proposal for such a program is being worked out with input from the governments of New Brunswick and Prince Edward Island. An outline of the proposal will soon be released so that growers can comment and contribute their ideas to the final program.

The program will emphasize disease control in seed stocks and will include a system of post-harvest testing.

Market Development

In conjunction with the quality improvement of Canadian seed potatoes, the federal government is proposing a major market development effort to boost seed potato exports. This program would be jointly funded by the industry and the federal government.

Research

The federal government will also step up its research effort on new potato varieties, storage techniques, disease control and whole seed production.

Storage

Funds will be available to producer groups under the Fruit and Vegetable Storage Construction Assistance Program to build or upgrade potato storage facilities.

Insurance

A new voluntary insurance plan for seed potato producers is also being proposed. Participating producers, provincial governments and the federal government would share premium costs. The plan would cover production, storage and market risks.

Further details on the insurance plan will be included in the outline of the seed quality program proposal to be released in early February.

Stabilization

The 1978 eastern Canada potato crop has been designated for support under the Agricultural Stabilization Act.

Based on the average market price in the previous five years and the increase in cash production costs, the support level under the act has been set at $3.92 a hundredweight. Grower returns in eastern Canada for 1978 potatoes averaged $3.52 a hundredweight.

A stabilization payment of 40 cents a hundredweight will therefore be made to potato producers in Ontario, Quebec and the Atlantic Provinces. Producers can apply for the payment on eligible sales of Canada No. 1 and Canada No. 1 Large table potatoes, equivalent grades of processing potatoes, and all classes of seed potatoes. The maximum claim for each producer will be limited to sales of 10,000 hundredweights.

Application forms will be mailed to growers and will also be available from local offices of Agriculture Canada's Produce, Dairy and Processed Products Division.

As with previous stabilization programs, growers must submit valid sales receipts to substantiate their claims. In cases of bona fide partnerships, up to three partners may claim payments if they can show distinct and proportionate investment, labor, management and risk or profit sharing.

Total stabilization payments are expected to be about $9.7 million.

Potato producers in western Canada had requested to be included in the 1978 stabilization program. However, grower returns in western markets averaged more than the support price calculated on the same basis.

However, western producers will benefit in the long term from the other initiatives being taken to assist the potato industry.

This six-point plan to assist potato growers should revitalize the entire industry, particularly in the Atlantic Provinces. It will resolve many of the industry's recent problems and put growers on a better footing to meet the marketing challenge facing them in the 1980s. The overall effect of this comprehensive range of programs will be to improve grower earnings and to strengthen the competitive position of the Canadian potato industry.

PUBLICATIONS

The following four publications are available free of charge from the Economics Branch, Ontario Ministry of Agriculture and Food, Legislative Buildings, Queen's Park, Toronto, Ont. M7A 1B6.

Economics Information, The Egg Industry in Ontario. A Contini and V.W. Yorgason. June 1979. 116 p.

An Overview of Land Use in Central Canada. T. Tosine. August 1979.

Physical Base for Agriculture in Central Canada. T. Tosine. October 1978.

Economics Information, Outlook for Ontario Agriculture 1980. 23 p.

Canadian Grains Industry Statistical Handbook 79. 269 p. *Available for $5.00 from the Canada Grains Council, 500-177 Lombard Ave., Winnipeg, Man. R3B 0W5.*

Critical Food Issues of the 1980's. Chow and Harmon. *Available for $14.10 from the Bergamon Press 1979, 150 Consumers Rd., Willowdale, Ont., M2J 1P9.*

The Development of Farm Credit in Canada. 181 p. *Available free from the Farm Credit Corporation, P.O. Box 6309, Postal Station J, Ottawa, Ont., K2A 3W9.*

Farm Machinery – Financial Management, Vol. 5 – Machinery – To Own or Not. W.W. Stokes and B.A. Hackett. 1979. 12 p. *Available free from the B.C. Ministry of Agriculture, Publications Office, Parliament Buildings, Victoria, B.C., V8W 2Z7.*

Feasibility of Establishing Potato Ethanol Plants on Prince Edward Island. Dr. Elizabeth Hall. *Available for $3.00 from the Institute of Man and Resources, 50 Water St., P.O. Box 2008, Charlottetown, P.E.I., C1A 1A4.*

Food or Famine, An Account of the Crop Science Program Supported by the International Development Research Centre. A.D.R. Ker. 1979. 79 p. *Available free from IDRC, P.O. Box 8500, Ottawa, Ont., K1G 3H9.*

Services and Programs for Rural Saskatchewan, 1979-1980. 244 p. *Available free from the Saskatchewan Department of Agriculture, Planning and Research Secretariat, Regina, Sask., S4S 0B1.*

IN REPLY TO AUTHORS AND EDITORS REGARDING FEBRUARY 1980 *CANADIAN FARM ECONOMICS*

I have read one or more of the following articles:

(1) Canada's Agricultural Trade with Developing Countries: An Analysis of the Past Level of Exports
(2) Structural Adjustment in the Quebec Dairy Farm Sector, 1971-1976
(3) Terms of Trade for Agriculture

1. My comments are on article number (1) (2) (3).
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Canada
K1A 0C5

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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Agriculture Canada

HON. EUGENE WHELAN, MINISTER — GAÉTAN LUSSIER, DEPUTY MINISTER

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Letters from readers: Letters are encouraged and should be addressed to the editor. Comments and suggestions are useful to editors and authors for effective two-way communication. Edited letters will be used in CFE with the writer's permission.

INTRODUCTION

This issue of Canadian Farm Economics contains a series of three papers commemorating the 50th anniversary of the establishment of Agriculture Canada's Economics Branch in 1929. These papers trace the evolution of the Economics Branch to its present status, the development of agricultural economics as a discipline in Canada and the main thrusts of agricultural policy during the period. Together they show how the branch and the discipline of agricultural economics have matured during the 50-year period and the way in which policy has evolved.

The branch's earliest mandate was to provide economic information. Its work was designed to provide this information through economic analysis that would assist in the formation of programs which fostered agricultural productivity and more effective marketing of agricultural products. The branch's output was quantitatively oriented from the beginning. However, its capabilities in economic analysis have been greatly strengthened by the development in economics of more powerful analytical techniques. These have enhanced the ability of economists to give empirical content to the comprehensive body of economic theory which had been in existence for some time.

The maturity of the discipline has therefore led to a much greater role for agricultural economics in the department and has particularly enabled economists to make a major contribution in the preparation of policy briefings and documents. As a result, the Economics Branch has now become the Marketing and Economics Branch.

I extend my thanks to those who were instrumental in establishing economics in the department and to all past and present staff members who by their dedication have made an impressive contribution to the analysis necessary for Canadian agricultural policy. This issue is a way of paying tribute to their work.

Gaétan Lussier
Deputy Minister

A HISTORY OF AGRICULTURE CANADA'S ECONOMICS BRANCH, 1929-79

Throughout its 50-year history, Agriculture Canada's Economics Branch (now the Policy and Economics Branch) has adjusted its programs and activities to meet changing needs and has made a significant contribution to agricultural economics as a discipline and to the development of Canadian agriculture.

*S.C. Hudson and M.E. Andal**

INTRODUCTION

Fifty years ago, on October 1, 1929, the Agricultural Economics Branch was established to provide the Department of Agriculture with information and advice on economic matters pertaining to policies and programs for agriculture. This article describes some of the highlights of the branch's development during the past 50 years, including some of the pioneers who played an important role in that development.

Throughout the period major economic issues were always in the forefront as agriculture adjusted to various economic and technological forces. For example, the number of farms declined well over one half and the size of farms, capital and output increased severalfold. During the first decade of this period the impact on agriculture of worldwide depressions and years of drought in the prairies was devastating. World War II and its aftermath in the second decade imposed further problems of economic adjustment. Along with these macroeconomic forces, unprecedented technological developments revolutionized the agricultural industry and created new problems in farm management, farm finance, agricultural adjustment and marketing and trade. The pressure on the Economics Branch to fulfill its role throughout these developments was severe and the pioneers must be given credit for the work they did and in assisting the government to establish appropriate policies and programs.

Before 1929, departments of agricultural economics had been established, or full-time staff in agricultural economics had been appointed, at most of the provincial universities. Economic problems related to marketing resulted in staff appointments in departments of agriculture in the provinces to deal with marketing and agricultural cooperatives – as early as 1912 in British Columbia and shortly afterwards in Saskatchewan and Ontario. Special divisions were established in the 1920s to deal with cooperatives in Nova Scotia, Quebec, Manitoba and Alberta. Some work of an economic nature was being carried out in the federal department.

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*Dr. S.C. Hudson is a former director general of the Economics Branch. Dr. M.E. Andal was director of the Economics Branch's Farm Economics Services. In preparating this article, the authors have drawn freely from articles by J.F. Booth and J. Coke in the *Economic Annalist* (issues of August, September, and December 1931 and February 1950); Dr. Booth's paper presented to the Canadian Agricultural Economics Society in 1946 entitled "Trends in the Development of Agricultural Economics in Canada;" from J.F. Booth's unpublished *The Economics Division Story*; from S.C. Hudson and I.F. Furniss, "Uses of Outlook in Canadian Agriculture," *American Journal of Farm Economics*, December 1966; and numerous other publications, mainly of the Economics Branch. Space limitations prevented the inclusion of some important developments and many individual contributions. The authors acknowledge helpful comments from F. Shefrin, G.J. Dobson and W.J. Anderson.

Studies of the cost of production of various farm products based on experimental data were conducted by the federal experimental farms and illustration stations. Early activities in marketing stressed reduction in processing costs and the collection and dissemination of information on prices and volumes of marketings.

THE BRANCH IS ESTABLISHED

The Honourable W.R. Motherwell, federal minister of agriculture from 1921 to 1930 founded the Economics Branch. He had been active in the cooperative and farm organization movements in the West and sought to establish a cooperatives branch in the department in 1927. In implementation the concept was broadened to include agricultural economics. Hence in 1929 he established the Economics Branch.

THE EARLY APPOINTMENTS

John F. Booth, the first commissioner of the Economics Branch, grew up on a Saskatchewan farm and was director of the Co-operation and Markets Branch, Saskatchewan Department of Agriculture, from 1920 to 1923. Booth resigned from that position to enter the graduate school at Cornell University, and from 1926 to 1929 was with the Bureau of Agricultural Economics, United States Department of Agriculture. One of the studies he conducted was on Canadian co-operative experiences.

Joe Coke, professor of agricultural economics at the Ontario Agricultural College, was appointed assistant commissioner. A highly competent, kindly, professional man, he was ideal for the position. Booth remained head of the branch until his retirement in 1960. Coke continued as his associate until he was incapacitated by a lengthy illness which resulted in his death in 1955. Booth died in 1976. C.M. Goddard, the private secretary to the former federal agriculture minister, Honourable Sydney Fisher, was invaluable as the assistant to the commissioner in setting up the new branch.

The next agricultural economist appointed to the staff of the Economics Branch was Albert Gosselin. He transferred from the Field Husbandry Division of the Central Experimental Farm in June 1930. A graduate of Laval University and l'Institut d'Agriculture d'Oka, he served more than 25 years as senior farm management specialist and liaison officer on agricultural economics with the Province of Quebec. He still lives in Ottawa and is considered the dean of former Economics Branch staff members. Also appointed from Quebec a few years later was G.P. Boucher who had graduated from Laval, had done graduate work at Toronto and later at the University of Minnesota. He was editor of the *Economic Annalist* for many years.

Another transfer to the Economics Branch from the Experimental Farms Branch was Albert E. Richards. He was supervisor of the illustration stations for British Columbia until January 1931. Richards did his undergraduate work at the University of British Columbia and obtained a master's degree from the University of Wisconsin and a Ph.D. from Cornell. In 1934 Richards inaugurated the Annual Survey of Co-operative Associations. This is still being carried out. He was also a member of Canadian delegations at conferences negotiating the establishment of an international trade organization which subsequently became the General Agreement on Tariffs and Trade. Richards retired in 1961 and lives in Sidney, British Columbia.

Among the student assistants joining the branch in June 1930 was S. Claude Hudson, who had recently graduated from Macdonald College. He did graduate work at Cambridge and Cornell and became the branch's director general in 1964. From 1955 to 1964 he undertook several special assignments. These included advisory work in developing countries, stints as secretary and later chairman of the International Wheat Council in London and director of the Agriculture and Fisheries Branch, Department of Trade and Commerce. Hudson retired in 1968 and also lives in Sidney, British Columbia.

A junior economist who joined the branch in 1931 was C.V. Parker. He later became private secretary to the minister of agriculture and director of the Agriculture Division, Statistics Canada. Parker conducted one of the branch's first marketing studies which served as the basis for a consolidation assistance program for cheese factories.

DELINEATING THE FIELD AND ESTABLISHING A MANAGEMENT STYLE

The original outline of activities for the Economics Branch encompassed seven areas: 1. cooperative marketing, 2. marketing, 3. farm management and economic surveys, 4. land economics, 5. rural sociology, 6. historical research and 7. education and publications. Soon, farm labor, credit, finance, taxation and transportation were added. Booth was aware that this program may have appeared overly ambitious and that it would be difficult to obtain financial support and staff but he felt it would establish the domain of agricultural economics. And this was essential not only within the

department but for the central departments as well. Economists in other departments were concerned mainly with legislative and policy matters. The Department of Agriculture, however, was specialized and had the additional responsibility of economics research as well as research in the natural sciences. This point had to be repeated many times in the ensuing decades.

Associated with the task of defining areas of responsibility was the problem of how to make the most effective use of the few trained economists available. Two approaches were used. One was to encourage the training and development of economists and the second was to use joint, cooperative arrangements with other agencies in studies undertaken. From the beginning, Booth and others strongly encouraged staff to do graduate studies and facilitated such arrangements. Another aspect of staff development was the delegation of responsibility and giving full recognition and credit to persons doing the work.

Evidence of a payoff from this approach to staff development occurred during World War II. Many staff members were seconded to various wartime boards and agencies. They also helped prepare legislation of the postwar development period such as the Veteran's Land Act and the Agricultural Prices Support Act. Departmental officials developed a better appreciation of what economists could do.

According to available records, the Department of Agriculture's economics branch was the first in the federal government. Many other departments later established economics units and drew on Economics Branch staff for key positions. In addition, many staff members went to provincial governments, universities, international organizations and the private sector.[1] While this represented a loss of staff, the branch still benefited from the better understanding and liaison that developed.

One of the Economics Branch's great contributions, particularly during its first 30 years, was the training of economists – not only for its own use but also for the staffing of economics units and positions in other departments, firms and agencies. There is little doubt that the early policies of staff development, delegation of responsibility and freedom of transfer had paid off.

Also from the beginning the branch recognized the need to work closely with provinces and universities. Many joint projects were undertaken and arrangements were flexible and informal. Arrangements were varied and depended on what each agency was best able to contribute. With limited resources the cooperating agencies accomplished much in land classification, settlement studies and farm management. These arrangments led to the establishment of branch regional offices. These offices were a principal source of firsthand knowledge on problems and developments in farming in the regions. Their work had special significance before the establishment of provincial economic units. The officers in charge included G.C. Retson in Truro, C.C. Spence as supervisor for Western Canada, Ted Riecken in Manitoba, Ralph Stutt and Jake Wiens in Saskatchewan, Gordon Haase in Alberta and E.D. Woodward in British Columbia. In 1966 the prairie offices were consolidated in Regina under the late T.O. Riecken.

WORK PROGRAM

The importance of publications to disseminate research results and to encourage more rigorous analysis and clarity of presentation was also soon recognized. Thus the *Economic Annalist,* the first periodical, was established in 1931.

Most of the early branch studies were on farm management. They covered a variety of farm types in widespread areas of the country. Marketing, taxation and credit were also topics in the early research program.

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[1] Some examples are as follows: Fisheries – Ian MacArthur and Neil Lewis; Trade and Commerce – W. Van Vliet, B. Marshall, W.C. Hopper, T.G.E. Woollam, D. Packman, E. Stewart and S.C. Hudson; Finance – W. Chown, H.R. Manery, D.W. Ware, L.E. Poetsche; Statistics Canada – C.V. Parker, W.D. Porter, W.L. Porteous, R. Campbell, H.K. Scott, E.S. Eaton and C.M. Jones. Those going to key provincial positions included H.L. Patterson, A.H. Turner, G. Purnell and three Kristjansons: Baldur H., Kris and the late L. Burbank. Universities absorbed W.J. Anderson, R. Nicholson and P.J. Thair. Graduates to the private and semi-private sectors included R.G. Knowles – C.B.C.; John Dawson – Economic Council of Canada and the Energy Research Institute, Keith Leckie – Meat Packers Council of Canada and Doug McRorie – the Royal Bank of Canada. E.P. Reid and several others went to international organizations.

Despite these losses the Economics Branch has been a close-knit unit. Many staff members spent all or nearly all of their careers with the branch. Some of these, other than those already mentioned are as follows: Lila Ferguson – a secretary from 1934-1969; A.E. Brown – a secretary and administration officer from 1938-1972; D.M.A. Burke (1949-1977) – secretary to all five heads of the branch to her retirement in 1977; E.B. Gordon – secretary and administration officer in Saskatchewan from 1948-1979. Presently on staff with more than 30 years service are A. Trempe and R. Daviault.

The 1930s drought and depression in the prairies emphasized the need for basic agricultural adjustments. The Prairie Farm Rehabilitation Act of 1935 was passed to tackle these problems. Under its programs funds were provided for soil and economic surveys. The Economics Branch did a comprehensive program of land use and classification studies in Saskatchewan and Alberta. As a result, about 40 million acres of land were classified according to potential productivity and much additional farm management information was obtained relating to different land classes. Studies on irrigation as a means of combating drought were also carried out.

The marketing problems of the 1920s were aggravated by the depression. One program seeking to improve marketing arrangements was the Natural Products Marketing Act of 1934. The branch was actively involved in developing the legislation and operating the resulting board. This act sought to delegate federal power to local marketing boards for regulating the marketing of farm products, but was later declared unconstitutional by the Supreme Court of Canada.

Following World War II a greater emphasis was placed on maintaining agricultural exports and in diversifying markets. In 1945 a unit on foreign agriculture was established in the branch to provide detailed information on agricultural developments in other countries, both importers and exporters. The following publications were developed to communicate this information: *Agriculture Abroad*, *Spot News* and the *Overseas Report on Agricultural Development*. The unit's work was subsequently expanded to encompass the Food and Agriculture Organization (FAO) and other international agencies such as the Organization of Economic Cooperation and Development (OECD), the World Food Program and the Inter-American Institute of Agricultural Science. These developments were under the direction of Frank Shefrin. When he retired in 1978 he had more than 30 years of experience on FAO work and more than 38 years of service with the branch. With the development of the Canadian International Development Agency's extended technical assistance program, the Department of Agriculture was called upon to provide expertise. The branch was given the responsibility of coordinating this under the supervision of T.G. Willis.

Associated with these international activities were the trade policy analyses and protracted trade negotiations. Gordon Dobson, director of the branch's International Trade Policy Division, took over these responsibilities from Albert E. Richards in 1958.

AGRICULTURAL OUTLOOK SERVICE

One of the farmers' early complaints was the lack of market information needed for farm planning. The agricultural outlook service was developed to meet that need. After several years of effort and promotion, the first Canadian Agricultural Outlook Conference was held on February 8 and 9, 1934. The reports of the conference were widely publicized – 40,000 copies in English, 15,000 copies in French and national radio coverage. The conference was held annually until 1940 when the government replaced much of the free play of market forces with wartime controls over the supplies and the marketing of farm products. However, a new publication, the *Current Review of Agricultural Conditions in Canada,* was started in July 1940 to provide information on current developments.

In December 1942 a conference was held to consider national production objectives for each commodity. The program continued in this form until 1947. In 1948 the outlook resumed its earlier format and, with modifications from time to time, has continued to the present. Branch staff work with interdepartmental committees and consult with provincial officials in the preparation of these outlook reports. J.R. Burns was the coordinator of this program for many years. Many provinces now prepare their own outlook reports. Officials from a variety of agencies, firms and governments attend the popular yearly outlook conference at which the annual reports are presented and discussed.

THE COST OF PRODUCTION ISSUE

In the beginning of its existence the Economics Branch ran into the problem of the suitability of using cost of production estimates for price support purposes. In August 1930 the government requested cost of production studies to assist with tariff applications. The branch opposed the request because of unreliable data, staff requirements and because the usefulness of the branch could be seriously curtailed if the results were not "favorable." The branch's view prevailed. The farm management studies done in the branch's early years usually dealt with operation efficiency but costs could often be calculated from the data. Average production costs were often higher than prevailing prices. While the reasons were obvious to economists the results were sometimes embarrassing to the minister since it appeared that his own studies showed that farmers were losing money! The branch eventually withdrew from this field for some time. Opposition to cost studies also restricted farm management and production economics studies. And this was discouraging to staff.

Reference to costs of production was made in the new Agricultural Stabilization Act (ASA) of 1958 and the branch was asked to assemble cost of production data for a wide range of commodities to help support prices. It was a major undertaking, including special surveys to fill gaps. In presenting results of this work, however, the ranges and distributions of costs were shown as well as the averages.

When other departmental officials and the government were confronted with the difficulties of obtaining representative farms, and saw that a number of somewhat arbitrary assumptions had to be made and that costs varied widely from farm to farm, they realized the weaknesses of the approach. Costs of production were therefore not used in a significant way to set support prices and the issue remained dormant for some time.

By the 1970s cost of production had become a factor in several stabilization programs. The hog stabilization program of 1974 took feed costs into account. The ASA provided for support prices to reflect changes in production costs. The Western Grain Stabilization Act provided for a net cash flow, taking costs into account. And cost of production in the egg marketing program found a place in administered prices.

POLICY ORIENTATION

For much of the period up to the mid-1950s, policy analysis and development was not a major branch preoccupation. This may have been related to a remark made by the minister, the Honourable J.G. Gardiner, that he didn't need any analysis of departmental policies by his own staff – for he got plenty of this in the House of Commons.

The conservative government elected in 1957, however, was anxious to review many of the policies about which they had been critical. Their principal concerns were with price supports for farm products, farm credit, crop insurance, low-income farmers and resources for the future. In the comprehensive review which ensued the Economics Branch was called upon to provide a great deal of information, analyses of policies and recommendations for improvements. After the agricultural prices support program was found to be inadequate, the branch had an important role in developing the new Agricultural Stabilization Act in 1958.

The government's Canadian Farm Loan Board had received much criticism in recent years for not meeting farmers' long-term credit needs. The government appointed a committee of three – T.J. Rutherford, Veteran's Land Act; A.S. Abell (once a member of the Economics Branch), Department of Finance and A.H. Turner from the Economics Branch to review and recommend new policies. The result was the Farm Credit Act of 1959 and the Farm Credit Corporation. Turner served on the first board of the corporation.[2]

One perennial problem was income instability due to crop failure. Hence the government wanted a crop insurance plan. Mel Andal had recently completed a detailed study on the Prairie Farm Assistance Act and was assigned to the crop insurance project. This led to the Crop Insurance Act of 1959. The first federal-provincial crop insurance agreement was with Manitoba. L.B. Kristjanson, a former Economics Branch employee, had much to do with developing the Manitoba plan and subsequent negotiations with federal officials.

The 1950s saw a marked increase in technology on farms. Many farmers were able to adjust to this phenomenon; others couldn't and either moved off their farms to other employment or remained with low incomes. The latter constituted the "small farm problem." Economics Branch staff assembled data, carried out research and appeared before House and Senate committees on this question. Parliament established the Senate Land Use Committee in 1957 and Ralph Stutt of the branch served as technical advisor to the committee. Booth chaired a committee which including Stutt, studied the U.S. rehabilitation program and reported to the senate committee and the department. This background work led to the Agricultural Rehabilitation and Development Act (ARDA) of 1961.

At about this time a concern developed about the future of natural resources, particularly agricultural resources. B.H. Kristjanson, a former branch employee, became secretary of the Resources for Tomorrow Conference held in late 1961. Branch staff contributed papers, research material and editing assistance. Other areas assigned to branch staff included unemployment insurance for farm workers, income support programs and acreage payments.

Concurrent with this shift in branch work was the establishment of economics units in provincial departments of agriculture. They took over many of the farm

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[2] The predecessor of the Farm Credit Corporation, the Canadian Farm Loan Board, like the Economics Branch, was established in 1929. Farm Credit Corporation, *Farm Credit – 50 years* (Ottawa: 1979).

management surveys and studies which formerly occupied much of the branch's activity.

OPERATIONAL ORIENTATION

CANFARM

Agricultural economists in general and the Economics Branch in particular have always advocated the need for farm business records in farm planning. To meet this need the Economics Branch developed a farm account book, which incidently, remained one of the top 10 best-sellers of federal publications for many years. Provinces, universities and banks also produced account books.

With the development of computer facilities, farmer commercialization and the increased load of time-consuming record keeping in the 1960s, the possibilities of electronic record keeping, to which clients could mail data, became apparent. Several agencies in Canada began development work. It occurred to those concerned that an excellent opportunity existed to combine resources, not only to develop the best possible system, but to standardize record keeping concepts, terms, definitions and systems. This hadn't been possible with the large number and variety of farm account books in use. In 1965 the Economics Branch, the Farm Credit Corporation, the Universities of Guelph and Saskatchewan and the Agricultural Economics Research Council (AERC) met to consider the development of one system for Canada. CANFARM, with an initial grant of $10,000 from the AERC, emerged from a major cooperative effort among federal and provincial governments and universities and became a division of the Economics Branch in 1969. Farm organizations and cooperatives which had supported CANFARM took over its operation in 1978.

Small Farms Again

Although ARDA had been passed to help small farms, they were in trouble again in the late sixties because of falling income. Investigating the problem took several years, however, and it was 1972 before the first federal-provincial agreement establishing the Small Farm Development Program was signed. It provided for land transfer payments to operators of small farms who might wish to move to other occupations, provincial advisory services and retirement for older farmers. But farm income and land values changed sharply for the better in 1972 and the program never became as active as originally envisaged. By 1979, other programs had assumed higher priority and the small farms program was abolished.

Other Program Developments

Space limitations prevent the discussion of many important areas of activity and staff contributions, but the following examples will indicate the wide range: Food Consumption and Nutrition Economics – C.I. Johnson, Flora Webster Shefrin and L.E. Drayton; Food Demand Studies – Frank Shefrin and Zenon Yankowsky; Wholesale Marketing of Fruits and Vegetables in Toronto – W.C. Hopper and E.P. Reid; Rural Sociology – Helen C. Abel, followed by Diana Ferris and Katherine Cooke; Air Photo Interpretation – pioneering work by L.E. Philpotts and Interdisciplinary Research – Vernon Miles.

THE BOOTH ERA

Although the emphasis on work during the past 50 years, under the six directors, has changed in response to perceived needs, the period from 1929 to 1968 could be called the Booth era. Although A.H. Turner headed the branch from 1960 to 1963 and S.C. Hudson from 1964 to 1968, and although each left his mark on the organization and activities of the branch, both were long-time associates of Booth and both were also trained at Cornell, and as long-time employees of the branch had contributed substantially to the organization and activities of the branch before assuming the position of director.

RESEARCH AND SERVICE – A BALANCE

One of the important concerns during the last 25 years has been to establish a balance between research and service work and to attain the most effective liaison possible between the two functions. Turner appointed a research coordinator, J.M. Fitspatrick, in a staff position to develop research for advisory and service needs and to encourage effective research coordination. In 1964 Hudson reorganized the branch into two divisions: Farm Economic Services, directed by M. Andal, and Marketing and Trade, directed by F. Shefrin. Each had an associate director of research. A program coordinator, H.R. Manery, was attached to the director general's office. The three prairie regional offices were combined into one research center in Regina. Two historical publications, the *Economic Annalist*, which published mostly research articles and the *Current Review*, more of a service publication, were combined to form *Canadian Farm Economics*, which remains the branch's flagship publication.

A NEW ERA

In 1968 Glen Purnell became the branch's director general. Three principal changes in organization were made at that time.

The first was the establishment of the Research Division; this separated the research from the service and advisory function. As more data and research results became available, staff members became more heavily involved in service and advisory work, mainly within the department but elsewhere as well. It was becoming more difficult for staff members doing both research and service work to devote enough time to research, hence it was hoped that separating the two would insulate researchers from service work demands. The other two divisions, Farm Management and Marketing and Trade, were maintained.

The second principal change was the establishment of the Economic Planning Unit. This group was also to be free from day-to-day service work in order to concentrate on guidelines for longer-term goals for Canadian agriculture.

The third was the consolidation of work with international organizations concerned with international intelligence and relations into the International Liaison Service under Mr. Shefrin. This group reported to the new assistant deputy minister of economics.

G.I. Trant succeeded Purnell as director general in 1972. Trant's views on organization and priorities are reflected in the reorganization of the branch and delineation of responsibilities which took place in March 1973.

Two small staff groups reporting to the director general were established. The Program Coordination and Development Group, directed by W.J. Anderson, was to evaluate and develop programs and recommend priorities and resource allocation within the branch. The Policy Advisory Group, directed by G. Hiscocks, was set up to examine issues in Canadian agricultural policies and to provide information, advice and leadership in the development of agricultural policy and programs.

The Research Division, directed by V. Gilchrist and T. Kerr, continued as a separate division. CANFARM had grown substantially by this time and was made a separate division directed by A.H. Harrison. The Farm Management Division, directed by D. Plaunt and W. Candler, became the Farm and Rural Development Division with changes in emphasis and responsibility for the Small Farms Development Program. The Marketing and Trade Division, directed by G. Dobson, and the International Liaison Service remained relatively unchanged.

The Administration Division was also established in 1973. J.A.F. Paquette, who holds the longest service record in the branch, was assistant director of administration when he retired in 1979.

The main feature of the period since 1972 was increased branch involvement in policy analysis and development. A major research project was the creation of a sector model of Canadian agriculture. Policy developments to which the branch made the major contribution in this period included the Western Grain's Stabilization Act, the revised Agricultural Stabilization Act, feed grains policy, dairy policy, the Farm Products Marketing Agencies Act, the National Food Strategy and the General Agreement on Tariffs and Trade.

A major reorganization occurred again in 1978 when the Economics Branch became the Policy, Planning and Economics Branch. This reflected the larger role established by the former branch in planning and policy development. The new organization also recognized the need for coordinating federal activities in the food sector and for harmonizing policies developed by various levels of government. An added responsibility – planning and evaluation for the department as a whole – was also assumed. This arose out of the increased emphasis on managerial accountability within the federal government, long-term planning and evaluating the effectiveness of current program efficiency.

To have a more direct interplay among research, advisory and service activities, research is now a responsibility for each of the three branch directorates – Market Analysis and Trade Policy, Agricultural Development and Planning and Evaluation. The branch is headed by Assistant Deputy Minister D.E.L. Maasland who reports to Deputy Minister G. Lussier.

The present establishment has approximately 232 positions with a budget of about $7 million. This is in marked contrast to the five staff members with a budget of $22,000 in the beginning. During its 50-year history the branch's growth has been uneven. Little growth occurred during the first few years because of the depressions. In the mid-to late 1930s substantial temporary staff were added through the facilities of the Prairie Farm Rehabilitation Act in the West. By 1940 there were perhaps 70 positions but only 16 were permanent. The number had increased to 135 by 1950,

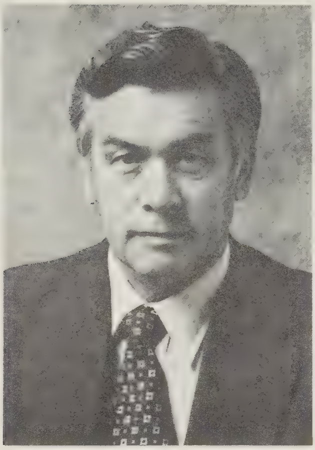
145 by 1960, about 235 by 1970 (including CANFARM) and now stands at approximately 232 (without CANFARM).

The branch's reporting relationship within the department has also changed during the period. In 1929 the branch was one of nine reporting to the deputy minister. In a departmental reorganization in 1938 it became a division of the Marketing Service and in 1960 a division of the Administration Branch. In 1964 the Economics Division again became a branch reporting to the deputy minister.

CONCLUSION

The influence and output of the Economics Branch has been substantial despite the fact that its budget has always been less than 1.0 percent of the total department's. As a branch and as a division in the Department of Agriculture, all activities, including articles and publications, have been directed towards policies, programs and research which would benefit the agricultural community. During its 50-year history the branch has adjusted its programs and activities to meet changing needs and has made a significant contribution to agricultural economics as a discipline and to the development of Canadian agriculture.

DEVELOPMENT OF AGRICULTURAL ECONOMICS AS A DISCIPLINE IN CANADA



J.C. Gilson*

In 1929 agricultural economics in Canadian universities was an adjunct to studies in either agriculture or political economy. In the intervening years it has developed through teaching, research and application into a discipline with its own departments, a professional journal and scientific publications. It has made a substantial contribution to microeconomics in agriculture and a respectable one to regional and national agricultural policy.

INTRODUCTION

October 1, 1979, marked the 50th anniversary of Agriculture Canada's Economics Branch. At the time of its establishment, the discipline of agricultural economics was in the very early stages of its development in Canada.[1] But it was not long before the profession was to be challenged by some of the most critical problems in the history of the agricultural industry. The federal minister of agriculture, the Honourable Robert Weir, indicated in 1931 that Canadian farmers and his department needed a wide research program in agricultural economics.[2]

On the occasion of the branch's 50th anniversary, we in the profession might ask ourselves what progress we have made in the discipline of agricultural economics during the past five decades. Have we become more scientific? Can we predict the outcome of events with greater accuracy and reliability? Are our students better trained? Have we succeeded in becoming more relevant and more useful to those, such as farmers, businessmen and policy makers, who look to and depend upon our profession for advice and assistance?

Self-examination is a healthy exercise in any profession, providing that it does not lead to a perennial state of professional hypochondria. As Lauren Soth expressed it:

> Being devoted to teaching the young and searching for new knowledge, living in semicloistered retreats, professors and researchers require mutual reassurance that they are doing things that are worthwhile in the real world.[3]

THE STATUS OF THE DISCIPLINE IN 1929

In the early stages of the development of agricultural economics in Canada, "political economy" was placed in

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[1] Excellent articles on the history of agricultural economics in Canada are in the following: J. Coke, "The Development of Agricultural Economics in Canada," *The Economic Annalist*, August 1932; J.F. Booth, "Economics Division, Canada Department of Agriculture Completes Twenty Years of Services," *The Economic Annalist*, February 1950.

[2] "A Message from the Honourable Robert Weir," *The Economic Annalist*, January 1931.

[3] L. Soth, "Agricultural Economists and Public Policy," *American Journal of Agricultural Economics*, Vol. 58, No. 5, December Proceedings Issue, 1976.

the curricula of agricultural colleges before formal courses in agricultural economics were offered. Teachers of the "political economy" courses for agricultural students came from a variety of "home departments," including English, animal husbandry and the offices of agricultural deans. Practical courses in farm management and marketing were among the first agricultural economics courses to appear in agricultural curricula.[4]

Early developments in agricultural economics were not confined to universities. The federal and provincial departments of agriculture were heavily involved in research and policy matters relating to issues facing the agricultural industry such as marketing, farm income issues, agricultural credit, transportation, export trade matters and cost of production studies.

University Departments

In 1929 the Department of Agricultural Economics at the University of British Columbia didn't exist. Courses in agricultural economics were taught by Professor Hare of the Department of Animal Husbandry and by Dean Clement of the Faculty of Agriculture.

At the University of Alberta the Department of Agricultural Economics wasn't founded until 1961, but some courses in the Department of Economics and Political Science were offered to agricultural students. One of the early teachers of these courses was Duncan MacGibbon, author of *The Canadian Grain Trade*, who was appointed to the Board of Grain Commissioners in 1929.

While the Department of Farm Management existed at the University of Saskatchewan in 1929, the agricultural economics option was provided by the Economics Department of the College of Arts and Science. Under this option the first two years of the program were devoted mostly to agricultural courses, while the last two years were usually given to straight economics, including the courses taught by Dr. Allen of the Department of Farm Management. Farm management was a formal option in the College of Agriculture in 1931.

The University of Manitoba had a department of agricultural economics and a four-year agricultural business option in 1929. Like Saskatchewan, the first two years of the option were devoted to science and agricultural courses, while the final two years primarily encompassed agricultural economics courses taught by the two members of the department. The department awarded the first master's degree in agricultural economics in 1932.

The Ontario Agricultural College at Guelph had a well-established department offering training in agricultural economics. The graduate work was under joint supervision of staff from Guelph and the Department of Political Economy at the University of Toronto. In addition to their teaching responsibilities, the department at Guelph was heavily involved in extension activities throughout the province.

The Department of Agricultural Economics at MacDonald College was started in 1926 and headed by Professor J.F. Lattimer. In addition to his heavy teaching responsibilities, Dr. Lattimer conducted agricultural surveys in Quebec and the Maritime Provinces and published extensively.

Instructions and research in agricultural economics were also being conducted in other institutions in 1929. For example, Dr. Longley, who was appointed to the staff of Truro Agricultural College in 1927, taught courses in agricultural economics. Professor Jackman was appointed Professor of Rural Economics at the University of Toronto in 1921.

Textbooks and Reference Sources

The nature and scope of a discipline at any given time generally can be determined from the textbooks and reference sources prescribed for the courses taught in the field of study. A brief sampling of the material used in 1929 yields some interesting insights into the discipline at that time.

There is no doubt of the influence which the graduate work, research and publishing at Cornell University and the University of Minnesota have had on farm management teaching and research in Canada. Few Canadian students in agricultural economics escaped the need to read such classics as H.C. Taylor's *Outlines of Agricultural Economics* or J.D. Black's *Introduction to Agricultural Economics.*

In statistics courses, which most established departments of agricultural economics required of their students, the most common book used appeared to be H. Jerome's *Statistical Method* and Ezekial's classic *Methods of Correlation Analysis*, published in 1930.

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[4] See J. Coke, *The Economic Annalist,* 1931, for an excellent discussion of the discipline's early developments in the agricultural colleges.

A popular Canadian reference used for several courses was MacKintosh's *Agricultural Co-operation in Western Canada,* one of the few texts published in Canada. Of course, many other textbooks and reference sources were used in 1929, but these best indicate the scope and treatment of the subject matter in agricultural economics at the time.

Research

There is an excellent survey of the research in agricultural economics around 1929 in the August 1932 issue of *The Economic Annalist.* The research projects covered a wide spectrum and were aimed mostly at practical and urgent problems of the day. Some of the more notable contributors to research included Allen, Booth, Coke, Drummond, Gosselin, Grant, Grindley, Hope, Lattimer, Longley, MacGibbon, Murchie, Stewart and somewhat later, Fowke and Britnell. All of these had an enormous influence on the affairs and policies of Canadian agricultural economics during the 1920s and 1930s.

MAJOR DEVELOPMENTS SINCE 1929

This section is confined to the major advances which have taken place in theory, methodology and quantitative analysis and the general impact which they have had on the discipline.

Theory and Methodology

One of the biggest changes in the theory of economic thinking undoubtedly came after the publication of J.M. Keynes' *The General Theory of Employment, Interest and Money* in 1935. The Keynesian revolution had an enormous impact on macroeconomic analysis and government fiscal policy.

Developments in welfare economics since 1929 have had a considerable influence on the conceptual treatment of decisions and policies at the micro and macro level of analysis. One need only mention names like Samuelson, Baumol, Satovsky, Arrow, Reder, Little, Bergson and Head to be reminded of the significant progress which has been made in this field during the past four decades.

The whole theory of economic dynamics, starting with economists such as Hicks and Harrod in 1939, and evolving through the work of economists such as Baumol in his *Economics Dynamics* and Samuelson in his *Foundations of Economic Analysis* are only examples of the dozens of publications which have emerged in this area since 1939.

Quantitative Analysis

The field of quantitative analysis has had spectacular developments in mathematical economics and econometrics and progress in complex model building coupled with the advent of the electronic computer.

The whole discipline of econometrics, which began with the publication of the first volume of *Econometrica* in 1933, expanded rapidly during the 1950s following the work of the Cowles Foundation. The publication of Leontief's *Structure of American Economy* in 1941, after 10 years of labor on input-output analysis, opened up an entirely new field of study. Dorfman's *Application of Linear Programming to the Theory of the Firm* in 1951 was representative of dozens of publications in this area.

Impact on Agricultural Economics

There can be no doubt that the progress in theory, methodology and quantitative analysis has had a pervasive influence on teaching and research in agricultural economics. The best summary of the advances which have been made in agricultural economics are in Lee Martin's (ed.) *A Survey of Agricultural Economics Literature.* The book by Fox and Johnson (eds.), *A.E.A. Readings in the Economics of Agriculture,* captures many of the milestone developments in the discipline since World War II.

Following are a few general observations on the development of agricultural economics as a discipline in Canada since 1929:

- The theoretical foundation of the discipline has been refined and new dimensions have been added.
- The quantitative capacity of researchers in the discipline has been enhanced.
- A more detailed and reliable data base has been developed for research.
- The applied aspects of the discipline have broadened during the years to embrace other interests and concerns such as ecology and natural resources.
- Greater specialization has occurred within the profession.

TABLE 1. STATUS OF DEPARTMENTS OF AGRICULTURAL ECONOMICS AT CANADIAN UNIVERSITIES, 1979

	University of British Columbia	University of Alberta	University of Saskatchewan	University of Manitoba	University of Guelph	MacDonald College	University of Laval
				number			
Academic Staff	6	13	10	15	20	6	10
Graduate Students							
Master's Students	7	32	12	31	24	5	19
Ph.D. Students	2	4	—	7	4	—	—
Undergraduate Student Majors	30	50	40	59	138	42	175

– Relatively strong and active departments of agricultural economics have been established at many Canadian universities. All of these departments have developed graduate programs at the master's degree level and some have established Ph.D. programs (Table 1).

GENERAL ASSESSMENT

Have we made progress in the discipline of agricultural economics since 1929? If we measure progress in terms of numbers of trained staff, graduate students, research projects, funding support and publication the answer is certainly yes. If it is defined in terms of the demonstrated application of theoretical advances to problems in agriculture the record has been spotty.

Agricultural economists in Canada have certainly performed well in applying the theory of the firm to microeconomic problems in agriculture. It is much less certain how well the advances in macroeconomic analysis have been applied to regional and national problems in the Canadian agricultural industry.

If progress in the discipline during the last 50 years is measured in terms of relevance, ability to predict events, interdisciplinary contributions to other agricultural disciplines or utility to the farmer or policy maker the answer is not an unqualified yes.

Lauren Soth made the following comment about the contributions of agricultural economists:

> As 'pure economists', more segregated from the political scene today, their influence has diminished. Agricultural economics undoubtedly has become more scientific, more scholarly, more knowledgeable about the farming business..... The more specialized you become, the less effective you are in the political economy. As our studies have become more intensive, more detailed, with greater use of mathematical techniques, inevitably they become narrower. The impact in public affairs is remote, long delayed, and indirect.[5]

Agricultural economists perhaps expected more than was warranted from the progress in theory and quantitative techniques for the empirical application and validity of their work. Elegance rather than relevance might have become the dominant criterion for progress in the discipline. A.S. Eichner made this observation:

> ... economic theory has become increasingly more elegant as a set of axiomatic statements about resource allocation under competitive market conditions. ...at the same time, economic theory has become less and less useful to anyone hoping to understand phenomena of the real world. ...it is this contrast between its elegance and its relevance that underlies the current crisis in economics.[6]

If there have been doubts at times about the progress in the discipline's relevance, it may be because the profession promised too much at an early stage in its history. And having promised too much, users of the results of our work maybe began to expect much more than the discipline could possibly deliver.

[5] L.Soth, op. cit., p. 798.

[6] A.S. Eichner "Post Keynesian Theory: An Introduction," *Challenge*, May-June 1978.

Maybe Keynes was closer to the mark:

> . . . The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist . . . I am sure that the power of vested interest is vastly exaggerated compared with the gradual encroachment of ideas. . . .sooner or later, it is ideas, not vested interests, which are dangerous for good or evil.[7]

Any notoriety enjoyed by agricultural economists from time to time has been due as much to their challenge of the vested interests, as to the fine tuning of their theoretical and empirical tools.

A TRIBUTE TO THE PIONEERS

If the pioneers in agricultural economics lacked the specialized skills, the advantages of recent theoretical advances, the computational and analytical capacity of modern computers, they had the advantage of being close to and part of the action. Agricultural economists were not dealing in 1929 with abstract problems or remote phenomena-bankruptcies. Market collapse and mass unemployment were an organic part of their work. These phenomena were urgent, critical and of immediate importance, and agricultural economists were confronted with and challenged to respond with helpful and meaningful advice.

Relevance, not elegance, measured the worth of agricultural economists in 1929 and the following decade. There was little time for a lecture on navigation when the ship was riding turbulent waters.

But it would be improper to denigrate the value of the progress in quantitative analysis, theoretical sophistication and in the specialization and depth of training in the agricultural economics discipline during the last several decades. These advances have been of enormous significance in the development of the discipline. The graduate of the profession and the results of the agricultural economist's research have met the test of the marketplace. But this progress should leave no room for complacency.

Elegance does have a place. Any science or discipline worthy of the name must be concerned with the rigor of its methods and the conceptual foundations for its work. But the ultimate test and worth of the agricultural economics profession in Canada will be measured in terms of its value to farmers, businessmen, consumers and policy makers.

The Honourable W.R. Motherwell saw the need for and the urgency of the work of the agricultural economists when he established Agriculture Canada's Economics Branch in 1929. The need and the urgency are no less today. I am confident that Canada's agricultural economics profession will be equal to the challenges which will confront it during the 1980s and beyond.

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[7] J.M. Keynes, *The General Theory of Employment, Interest and Money*, Harcourt, Branch and Co., New York, 1935, pp. 383-384.

DEVELOPMENTS IN CANADIAN AGRICULTURAL POLICY, 1929-79

Macroeconomic forces arising out of the depression, World War II, the subsequent technological revolution and uncertainties of the seventies have provided the background for Canadian agricultural economic policy. It has been concerned mainly with increasing bargaining power, stabilizing incomes, achieving income parity and preserving the family farm. Policy incomes have been relatively successful in achieving these objectives.

*E.L. Menzie**

INTRODUCTION

Agricultural policy developed during the last 50 years has been a function not only of problems and circumstances of the times but of developments before this period. A study of agricultural policies reveals more of a persistent pattern of development than of immediate circumstance. As suggested by Fowke, "The significant features of Canadian Agricultural Policy become apparent only as the historical functions of Canadian Agriculture are understood."[1]

Agricultural producers during the late 1800s and early 1900s felt strongly about the need for market power. They thought they were basically at the mercy of the railroads, grain dealers, wholesalers and other buyers or handlers of their produce. Similarly, they believed they were faced with powerful interests dictating the prices producers must pay for product inputs and services.

Farmers tried to improve their position by collective action – largely through establishing both buying and selling cooperatives and lobbying for legislation to improve competitive practices. The first real government involvement in grain marketing came during World War I, but ceased after the war despite farmer protest. During the 1920s, wheat pools were formed in the Prairie Provinces to handle and sell grain. Other cooperatives, such as the fruit growers in British Columbia and various dairy groups, were formed to improve producer bargaining power.

The lack of control over all producers and the general economic collapse of 1920 forced farm groups to increase pressure on governments for market intervention. Producers have continued this drive for increased government involvement to improve their position relative to that of the rest of the economy.

While the pressure for more government involvement in product sales resulted from producers' perceptions of their problems in the late 1920s, general acceptance of government involvement in other aspects of policy took place much earlier. Government policy on land

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[1] Vernon C. Fowke, *Canadian Agricultural Policy: The Historical Pattern* (Toronto: The University of Toronto Press, 1946), p. 3.

settlement was geared to agricultural expansion, as were subsidized transportation, policies to expand agricultural exports, credit to agriculture and aids to education, research and extension. All major nations have pursued such policies in the name of agricultural assistance. The expanded output and low food prices that resulted primarily benefited consumers. Thus Canadian agriculture, although increasingly productive, was in a poor position relative to the rest of the economy. The resulting adverse terms of trade position, and the continuous pressures for adjustment associated with increasing productivity, convinced farmers that they needed action to improve their bargaining position.

THE 1930s – A DECADE IN TURMOIL

The depression began with the break in world prices in 1929. ". . . during the early Thirties, the terms of trade ran very seriously against agriculture; farm income sank to ruinous levels with net farm income in Canada declining from $642 million in 1928 to $109 million in 1933."[1] The severe decline in farm income during the 1930s, unlike other sectors of the economy, was not accompanied by a major reduction in output. This further emphasized the farmers' relatively weak bargaining position.

The depression also placed ruinous pressure on farmer cooperatives. The wheat pools in 1930 paid members $1 a bushel on the 1929 crop. The market price, however, dropped to nearly $.50 and the pools were forced to go to the federal government for help. The government guaranteed the bank loans but required a government appointed manager for the pools' Central Selling Agency. From 1930 to 1935, in a gamble on market improvement, the government managed Canadian wheat sales by purchase and storage operations.

"In 1935 the Canadian Wheat Board was established and producers were given the choice of selling through the open market or through a government Board at a minimum guaranteed price."[2] The board operated in this manner from 1935 to 1939, with guarantees low enough to maintain the market option (except for 1938 when all wheat went to the board and the government incurred heavy losses). "In 1939 the government again wanted to get out of the wheat marketing and only vigorous representation by the prairie interests persuaded the government to maintain the optional Wheat Board."[3]

In addition to government intervention in wheat marketing during the 1930s, other areas in the support for free market operations in agriculture broke down. A growing belief that monopolies existed in non-agricultural sectors lent support for regulating competition in industry and led to measures to increase agriculture's market power. Producer pressure gave way to the Natural Products Marketing Act (NPMA) of 1934, providing for a federal marketing board. This board was to be given, or could have delegated to local producer groups, power over the sale and handling of products. This act, however, was annulled by the Supreme Court in 1936, since the federal government did not have jurisdiction over intraprovincial trade. "The initial passage of the NPMA, however, gave added encouragement to the movement for producer-owned cooperatives. Within eighteen months of its passage and before it could be found unconstitutional, twenty-two cooperatives were planned and nineteen were in operation."[4]

While the attempt to establish national marketing boards in the 1930s was thwarted by the courts, the passage of such legislation signalled a policy shift. Farmers had been trying for years, without success, to obtain government support for centralized producer control over all sales. The depression had provided the circumstances necessary to trigger this change. Although the federal legislation was revoked, several provinces passed legislation to provide market control within their jurisdictions.

In addition to marketing legislation, other special programs were enacted during the depression. Debt Adjustment Boards were established to deal with special problems of prairie producers. The federal government passed the Farmer's Creditors Arrangement Act of 1934. This act created Boards of Review with powers to adjust debts to the farmer's capacity to pay. About 32,000 families benefited, with reductions of about one-third in their farm debt. The Prairie Farm Rehabilitation Act was passed in 1935 to rehabilitate areas on the Prairies. Work was undertaken to improve farm practices with particular emphasis on soil conservation and rehabilitation. The Prairie Farm Assistance Act of 1939 was inacted to provide farmers with crop failure insurance.

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[1] Drummond, Anderson and Kerr, op. cit., p. 33.

[2] Ibid. p. 38.

[3] Ibid. p. 39.

[4] Robert W. Crown and Earl O. Heady, *Policy Integration in Canadian Agriculture* (Iowa State University Press, 1972), p. 9.

THE WAR YEARS: 1939-45

While specific policies during 1939-45 reflected the needs of the wartime situation, the general policy mood remained the same. Farmers continued to push for market power in handling and selling their products. The government, on the other hand, kept resisting these pressures and supporting a policy of low food prices.

During the early war years, farm prices, especially grains, remained depressed. Wheat stocks rose to record levels and market prices dropped to their lowest levels since the inception of the Canadian Wheat Board (CWB) in 1935. It wasn't until 1941 that a significant improvement occurred because of increased demands from the United Kingdom and increased pressure from farmers. These demands resulted in new policies to influence production.

Subsidies and price supports encouraged production changes. The primary purpose was to cause a shift from wheat to livestock production. Quotas on wheat deliveries were initiated with bonuses paid to producers meeting acreage reduction targets. Subsidies were paid on such items as feed-freight, farm gasoline, fertilizer, feed grain production and hog production. Some feed grain storage and elevator charges were also subsidized.[5] Import duties on farm machinery were removed in 1944.

While subsidizing farmers, the government also instituted price controls, at first selectively, then generally. Fixed prices were established for many products. Direct or indirect subsidies were paid where prices were considered inadequate. "The combination of price controls and subsidies was an effort to control resource allocation during the war period, and to minimize the economic and social dislocations which would have been created by uncontrolled wartime inflation."[6] Despite the subsidies and floor prices, farm groups continued to press for price parity. They were also concerned that the expanded production to meet wartime needs would result in another post-war depression. Thus the temporary Agricultural Prices Support Act of 1944 was passed to assist in an orderly adjustment from war to peace. The Act passed ". . . as a transitional measure and extended on a permanent basis by amendment in 1950, made provision for price stabilization by a board of three members."[7] The board had authority to buy and sell commodities at set prices and to pay producer subsidies if necessary.

Aside from price controls and subsidy payments, one of the most important policy actions was taken in 1943 when the CWB was given full control over commercially marketed wheat. This was in response to pressure from producers who were faced with relatively depressed prices, heavy stocks of wheat and acreage reductions. This was a major policy victory for producers who had been fighting for such action for more than 20 years. This policy has continued to this day and has had a major impact on the entire industry – indeed, upon the total Canadian economy.

THE CANADIAN GREEN REVOLUTION: 1945-70

In the immediate postwar era much of the government's action was directed towards normalizing the economy. Policies such as the 1944 Prices Support Act were instituted temporarily to help adjust to market conditions, but the prime concern was to return to a market economy. Government was interested in increasing productivity and promoting both domestic and foreign sales.

While the major focus was on returning to a market economy, there was also strong concern for price and income stability in agriculture. In addition to price support legislation, the government negotiated long-term contracts with the United Kingdom such as the five-year wheat agreement. Canada also actively supported the International Wheat Agreement of 1949.

The CWB Act was amended in 1947 to continue the board's exclusive powers in wheat marketing. It also facilitated government action in long-term contracts with the United Kingdom. In 1948 the board's powers were extended to include barley and oats. These extended powers took agriculture towards more government control. In a similar manner the Agricultural Products Marketing Act of 1949 gave provincial producer groups extensive powers over the marketing of their product in both interprovincial and foreign trade.

Government policy generally favored the strong family farm aided by government expenditures on research,

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[5]See Frank Shefrin and Marjorie R. Cameron, *The Wartime Subsidy Program of the Dominion Department of Agriculture* (Ottawa: Economics Division, Department of Agriculture, 1946).

[6]Drummond, Anderson and Kerr, op. cit., p. 50.

[7]C.E. Britnell and V.C. Fowke, *Canadian Agriculture in War and Peace, 1935-50* (Stanford University Press, 1962), p. 115.

education and extension. "The rapidly changing technology in agriculture brought increased requirements for capital to finance farm operations in the 1950s. To assist in meeting this demand the federal government and almost all provincial governments introduced new farm credit programs. During this decade provincial governments intensified their extension activities with increased emphasis on conservation, quality improvement, eradication of disease, increased production and farm management."[8]

Concerns about income instability and the unfavorable ratio of farm to non-farm income were sufficient to continue a minimum form of price supports, to provide for some subsidy payments and to expand bargaining power through marketing boards. Increasing production and unstable international markets in the 1950s brought demands for even greater income support. Thus the Agricultural Stabilization Act (ASA) of 1958 (providing more precise and higher level support) was passed to replace the postwar support program. Prices for 9 commodities were to be maintained at 80 percent of the previous 10-year average price. However, subsidy payments were limited as they favored smaller producers. Grains handled by the CWB were not covered by the ASA. Support for grains came largely through advance payments and a two-price system introduced in the late 1960s. CWB policies and increasing grain productivity resulted in substantial wheat stock-piles in the late 1960s and early 1970s.

Policies during this era were not all directed towards commercial agriculture. The Agricultural Rehabilitation and Development Act (ARDA) was passed in 1961 to relieve rural area poverty and to improve resource use. Research was to be conducted to determine the needs of the rural poor and how their conditions might be improved. Provision was made for removing marginal lands from agricultural production and for improving lands where new practices such as drainage were possible. ARDA programs provided for farm consolidation and resettlement assistance. Included in assistance programs were education, training, removal to new areas and aid in the development of local industry. "Instead of the traditional approach to trying to raise low farm incomes by increasing prices of the products sold, ARDA attempts to bring about structural changes in the farm units themselves and in marginal rural communities."[9] In 1965 the ARDA was renamed as the Agricultural and Rural Development Act. The emphasis was changed from improving land use to reducing poverty. More assistance was directed at aiding farm consolidation and assisting marginal farmers to adjust to alternative activities.

POLICIES OF THE 1970s

For most of this century Canadian farmers have fought for increased control over the marketing of their products. Since the 1920s and 1930s they have pressed for greater price and income stability and for increased parity with other sectors of the economy. These demands have persisted in the 1970s despite a drastic increase in agricultural income. In the early 1970s a world grain shortage nearly eliminated the stocks acquired in the previous decade. Increasing world food demands and rising energy costs have helped to sustain a favorable situation for agriculture. Policies in the 1970s have emphasized stabilization and marketing.

A recent task force report outlines current agricultural goals.[10] For consumers these include reasonable, stable food prices and adequate, dependable supplies of high quality, nutritious food. For producers the goals call for fair and stable returns with reduced disparities within agriculture. Other goals include the improved quality of rural life, a balanced rural-urban population, resource conservation and the fulfillment of our international responsibilities in food supply.

Many policy instruments are being used to help achieve these goals. Taxation, income supplements, subsidies and other programs attempt to assure adequate food supplies to consumers. Health regulations and consumer education help secure safe food supplies. Orientation of production favoring domestic sources attempts to provide food security on a national basis.

Increased producer returns and reasonable consumer prices are attained through efficiency in production and marketing. Federal government policy has supported and continues to support research and education programs designed to facilitate efficiency and increase output. "Agriculture Canada conducts over 50 percent of the agricultural research in Canada."[11] Government

[8] Federal Task Force on Agriculture, *Canadian Agriculture in the Seventies* (Ottawa: Government of Canada, 1969), p. 275.

[9] Federal Task Force on Agriculture, Ibid., p. 416.

[10] Task Force Report, *Orientation of Canadian Agriculture, Vol. I* (Ottawa: Agriculture Canada, 1977), p. 12.

[11] Ibid., Vol. I, Part A, p. 210.

policy has also been designed to expand both domestic and foreign markets to increase producer returns.

Government policies in the 1970s were designed to continue and expand producer's bargaining power so that their returns could expand and stabilize incomes. Marketing boards have been fostered in every province using such techniques as full production and marketing controls on some products, e.g., eggs, milk, broilers, turkeys and tobacco.

The Farm Products Marketing Agencies Act of 1972 provided producers with the legal basis to establish national marketing agencies for poultry products. It also gave them power to implement national marketing plans. National agencies have been established for chickens, turkeys and eggs with power to establish and allocate a national production quota to provinces and to generally manage the marketing of these products. In 1979 there were more than 100 marketing boards handling over 50 percent of all agricultural sales in Canada.

The CWB continues to be the sole agent for marketing prairie wheat and feed grains. The Canadian Dairy Commission, established in 1966, manages industrial milk production and marketing. It administers production quotas and prices, pays producer subsidies and subsidizes exports with producer levies.

Agricultural interests continue to be concerned about instability. In addition to legislation pertaining to marketing boards and agencies, the government has enacted further stabilization legislation. The Agricultural Stabilization Act of 1975 replaced the Mandatory Act of 1958. "The Act makes it mandatory for the Federal Government to stabilize the prices received by producers of nine named commodities (industrial milk and cream, beef cattle, hogs, sheep and lambs, corn, soybeans, and oats and barley grown outside the designated area of the Canadian Wheat Board) to a level which is at least 90 percent of the average market price over the past five years, adjusted for changes in cash production costs."[12] Other products may also be designated under the act.

The CWB continues a stabilization policy through its initial payments program which guarantees the price to be no less than the initial price which is announced before planting time. The government has also fixed the maximum price for domestically consumed wheat. If export prices exceed this level producers are provided with the difference.

The Western Grain Stabilization Act is intended to provide income stability. This act provides for a fund based on contributions, one-third from producers and two-thirds from the federal government. Producers receive payments when the receipts in the prairie region drop below the previous five-year average adjusted for changes in production costs. A crop insurance program is operated with producers and federal and provincial governments sharing the premium costs.

While the number of farms has declined more than 50 percent in the past 30 years and while farm size has increased dramatically, basic policy objectives are to maintain the family farm structure. The arguments for retaining the family farm structure include economic efficiency, social desirability, reduced environmental concerns and the need for a rural-urban population balance.

SUMMARY

Development of agricultural policy has been a long, evolving process with a basic, persistent theme. Farmers have struggled for greater bargaining power, improved income security, improved parity relative to that of the rest of the economy and continuance of the family farm. They have been relatively successful in each of these areas. Greater bargaining power has been attained through legislation supporting cooperatives and marketing boards. Improved price and income stability has been attained through actions of the producer boards and stabilization legislation. The 1970s have produced incomes for farmers at levels equal to or greater than those of their non-farm counterparts. While farm size has increased and numbers declined, the family farm is still the dominant form of ownership.

The government and consumer interests have at the same time continuously pursued policies to provide a safe, secure food supply at reasonable prices. These objectives have largely been met through various health and other protective regulations. Supply security has been assured through the maintenance of a healthy, productive agricultural sector. And food supply has been sustained through domestic production and exports to pay for needed food imports. Research, education and extension programs and other aids to adjustment have helped assure a progressively efficient food system. This efficiency has been reflected in the relatively low percentage of income Canadians spend on food.

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[12] Ibid., Vol. III, p. 30.

ECONOMIC INDICATORS

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978 I	1978 II	1978 III	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual
Production and Income											
1. GNP at Market Prices[a]	$ mil.	221,428[b]	228,052[b]	233,600[b]	238,548[b]	230,407[b]	249,308[b]	255,964[b]	265,080[b]	271,780[b]	260,533
2. Farm Cash Receipts Total[d]	$ mil.	2,929.9[b]	2,727.0[b]	2,900.3[b]	3,341.6[b]	11,899.0[b]	3,365.3[b]	3,237.9[b]	3,436.2[b]	3,908.1[b]	13,947.5
3. – Total Crops[d]	$ mil.	1,470.7[b]	1,026.4[b]	1,161.0[b]	1,248.0[b]	4,906.1[b]	1,458.3[b]	1,186.1[b]	1,468.5[b]	1,790.4[b]	5,903.3
4. – Total Livestock[d]	$ mil.	1,360.5[b]	1,612.0[b]	1,645.3[b]	1,923.7[b]	6,541.5[b]	1,830.9[b]	1,930.3[b]	1,866.2[b]	2,026.9[b]	7,654.3
5. Net Income Rec'd by Farm Operators[a]	$ mil.	3,020.0[b]	4,152.0[b]	3,252.0[b]	3,632.0[b]	3,541.0[b]	4,080.0[b]	4,584.6[b]	4,016.0[b]	4,224.0[b]	4,226.0
Trade											
6. Agricultural Exports	$ mil.	946.4	1,230.5	1,261.3[b]	1,391.8[b]	4,846.3	1,204.4	1,354.7	1,663.9	1,884.8	6,107.8
7. Agricultural Imports	$ mil.	876.7[b]	1,088.5	943.2	1,104.4	4,015.06	1,129.2	1,181.6	1,129.4	1,240.4	4,680.6
8. Real Domestic Product, Ag[a]	1971=100	119.5[b]	114.3[b]	117.5[b]	119.7[b]	117.8[b]	118.0[b]	118.3[b]	115.8[b]	113.0[b]	116.4
9. Real Dom. Prod., Less Ag[a]	1971=100	133.6	135.1[b]	136.6[b]	138.3[b]	135.9[b]	139.4[b]	139.3[b]	141.3[b]	141.2[b]	140.3
Price Indexes											
10. Farm Input Price Index	1971=100	190.8	200.2	203.2	209.2	200.9	224.0	228.9[b]	230.5[b]	234.1	229.4
11. – Buildings and Fencing	1971=100	193.5	197.6	203.1	209.9	201.0	216.1	223.2	229.5	235.3	226.0
12. – Machinery & Motor Veh.	1971=100	172.6	174.0	176.0	182.1	176.2[b]	188.0	191.8[b]	196.2[b]	205.3	195.3
13. – Crop Production	1971=100	217.9	225.5	228.3	230.2	225.5	238.6	252.5[b]	258.5[b]	266.5	254.0
14. – Animal Production	1971=100	178.0	203.7	207.3	218.2	201.8	246.8	252.3[b]	249.2[b]	247.8	249.0
15. – Hired Farm Labor	1971=100	214.5	217.9	223.9	225.4	220.4	228.0	232.8	235.7	237.8	233.6
16. – Interest	1971=100	284.5	284.5	284.5	284.5	284.5	310.6	310.6	310.6	310.6	310.6
17. Farm Prices of Ag. Prod.[d]	1971=100	192.7	206.8	209.9	221.9	217.6[b]	250.3[b]	250.7	247.7	246.4	248.8
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	153.9	372.9	418.8	342.4	1,288.0	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	458.0	462.3	479.3	490.3	473.0	499.7[b]	497.7[b]	466.7[b]	475.3	484.9
20. Av. Farm Labor Rates	$/hr.	3.67	3.73	3.78	3.84	3.76	3.89	3.95	4.01	4.08	3.98
21. Av. Hourly Earnings-Manuf.	$/hr.	6.67	6.77	6.87	7.03	6.83[b]	7.19[b]	7.37[b]	7.50	7.68	7.44
22. F.C.C.-Gross Loan Disburs.	$ mil.	78.4	127.8	205.7	121.7	533.6	35.4	174.7	192.4	145.2	547.7
23. CPI – All Items	1971=100	169.2	173.3	177.7	180.5	175.2	184.6	189.4	193.1	197.6	191.2
24. – Food at Home	1971=100	194.8	208.3	218.7	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0
25. – Food Away from Home	1971=100	192.6	194.9	202.2	207.3	199.3	213.1	220.8	227.3	232.4	223.4
26. Industry Selling Price Index – Food & Beverage	1971=100	195.1[b]	204.6[b]	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.3[b]	237.5	231.7

continued

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (concluded)

Item	Units or Base	1978 I	1978 II	1978 III	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual
Other Indicators											
27. Unemployment Rate	%	8.4	8.5[b]	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1	7.3	7.5
28. Exchange Rate	$ U.S.	1.11	1.13	1.14	1.18	1.14	1.19	1.16[b]	1.17	1.19	1.20
29. Av. Rate on New Demand Loans	%	8.70[b]	9.66[b]	10.03[b]	12.32	10.18	12.31	12.55	12.81	15.27	13.24
30. Quarterly Pop. Est.	mil.	23.39[b]	23.44[b]	23.50	23.55	23.48	23.60	23.65	23.69	23.74	23.67

[a] Seasonally adjusted at annual rates.
[b] Revised.
[c] Preliminary.
[d] Excludes Newfoundland.
[e] Excluding repair parts.
[f] N.A. = Not available.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Policy and Economics Branch, Marketing and Trade Division; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the Bank of Canada Review.

NOTES

The following notes were adapted from recent News and Features articles prepared by Agriculture Canada's News Media Services.

BEYOND PROVINCIAL BORDERS

Most Canadian farmers have probably never heard of the Agricultural Products Marketing Act (APMA), even though it is the legal authority behind billions of dollars worth of farm trade.

The act applies to regulated products – those controlled by farm commodity marketing boards. About 60 percent of Canadian farmers' $15 billion cash receipts is handled by marketing boards.

So far, 79 of Canada's 114 farm commodity boards have received permission to engage in interprovincial and export trade under the terms of the APMA.

The British North America Act gives interprovincial and export trade responsibility to the federal government. Through the APMA this authority can be delegated to provincial marketing boards by direct request to Agriculture Canada.

The APMA is also used to allow marketing boards to collect levies for financing or promoting sales beyond the province.

When a marketing board is created by a provincial government, a marketing plan and regulations are established for the regulated commodity within the province. By using the APMA, the marketing board can obtain for its producers the same benefits for interprovincial and international trade as it has for within-province trade. In a way, it extends the marketing board's power.

For commodities covered by national marketing agencies – eggs, chicken and turkey – interprovincial and export authority is conferred through the National Farm Products Marketing Agencies Act. Milk marketing boards are covered by the APMA, but their regulations are administered directly by the Canadian Dairy Commission.

Unregulated products (like beef) are not covered under the APMA or other national marketing legislation.

CANADIAN FARM AID TO TANZANIA

Canada has signed a new agreement with the East African country of Tanzania to help it move toward self-sufficiency in wheat production. Canadian aid for the five-year agreement is $37 million.

Large areas of Tanzania resemble the Canadian prairies and hold great promise for wheat production. The new agreement is a continuation of a program started 10 years ago to develop that potential.

The aim is to put in operation a 10,000-acre wheat farm in each year of the new agreement and provide research facilities and technical expertise to train Tanzanians to manage the farms.

The program has already developed two wheat farms and a third is close to completion.

Tanzania first approached the Canadian government for help in the late 1960s. About 20,000 acres of wheat were then being grown, mainly on large estates operated by Europeans.

The Canadian International Development Agency (CIDA) became involved when a research project was started. CIDA also was asked to supply several farmers from the Canadian prairies as advisers to a large wheat farm started by the Tanzanians.

The research, combined with the practical experience of the prairie farmers, paid off. Yields were raised from seven bushels an acre to about 24 bushels an acre by 1976. This was done mainly through increased mechanization and by adjusting planting time from December to February to better suit the rainfall pattern of the drier, highland areas of East Africa.

Agriculture Canada became involved in the program in 1975 to provide technical assistance. J.S. Clark, director of Agriculture Canada's Land Resource Research Institute in Ottawa, is director of the wheat research and production project in Tanzania.

With the good clay soils in the area and Canadian expertise, yields can be expected to go as high as 40 bushels an acre and increase dramatically the area of Tanzania planted to wheat.

Farms now in operation supply about one-quarter of Tanzania's wheat needs. Dr. Clark estimates that it will take another 10 years to make the country self-sufficient in wheat.

The main priority is to train Tanzanians to run the farms, but this takes time because they are not used to large machines and sophisticated technology. There will be about $2 million worth of equipment, including large seeders and combines, on each farm.

Planting time is critical after the rains, and this makes it necessary to plant about 1,000 acres a day. This can only be done with high-powered machinery.

The research aspect of the program is also essential. New and better soil and crop management practices have to be developed and disease research may become more important as more wheat is grown. New areas of the country suitable for expanding wheat production will be identified.

To carry out the research, $6 million is slated toward the building of a new research station near Arusha, in the north. The station also will make it possible for Tanzania to study the feasibility of growing other crops, such as oil and field crops.

About $17 million of the $37-million-project funds will be put toward technical aid, including research and training.

Water management is critical to the success of the project. Surface water must be stored for weed and pest control spraying as well as for the farm workers. Dams and other structures may have to be built to store water and help control soil erosion.

Another major area of concern is transportation. Most of the wheat is shipped by truck to major centers such as the capital, Dar es Salaam. The existing roads are so rough that only small trucks can be used. It took 30,000 truck trips to get the wheat out from one farm. The project team now is looking at the possibility of building all-weather roads.

One final concern is the need to maintain machinery and supply spare parts. To overcome this problem, CIDA is establishing a machinery service center.

PUBLICATIONS

The following six publications are available free from the Publications Manager, Marketing and Economics Branch, Agriculture Canada, Room E-132, Sir John Carling Building, Ottawa, Ontario, K1A 0C5.

Food Market Commentary. March 1980, 45 p., Cat. No. A80-751/Vol. 2, No. 1.

Incomes of Farm Taxfilers, 1976. W. Darcovich and D. Leung, Publication No. 80/2, March 1980, 120 p.

Market Commentary – Animals and Animal Products. G.E. Pugh *et al.*, March 1980, 42 p.

Market Commentary – Grains and Oilseeds. C.V. Fulton *et al.*, March 1980, 53 p.

A Quarterly North American Forecasting Model. Karl D. Meilke and Larry Young, University of Guelph for Agriculture Canada, Working paper, September 1979, 107 p.

Selected Agricultural Statistics for Canada. R. Daviault, Publication No. 80/1, March 1980, 138 p.

The following three publications are available free from the Department of Agricultural Economics, 403 Agriculture Building, University of Manitoba, Winnipeg, Manitoba.

National Food Policy Proceedings of the Agricultural and Food Marketing Forum. R.M.A. Lyons (ed.), November 1979, 234 p.

A Submodel of Fertilizer Demand and Prices in Eastern and Western Canada. M.H. Yeh, D.F. Kraft and S.Y. Sun, June 1979, 43 p.

Trade and Aid – Proceedings of the Agricultural and Food Marketing Forum. Ed. – R.M.A. Lyons and Norman J. Beaton, January 1978, 113 p.

The following two publications are available free from the Ontario Ministry of Agriculture and Food, Queen's Park, Toronto, Ontario, M7A 1B7.

Economics Information – Economic Study of Beef Feedlots, 1973-1978. F.R. Abraham, October 1979, 28 p.

Economics Information – The Egg Industry in Ontario. A. Contini and V. W. Yorgason, June 1979, 40 p.

The following two priced publication are available from Renouf Publishing Co. Ltd., 2182 St. Catherine Street West, Montreal, Quebec, H3H 1M7.

FAO Agricultural Commodity Projections 1975-85. *Food and Agricultural Organization* (FAO) of the United Nations (UN), 1979, 128 p.

The State of Food and Agriculture 1978. FAO of the UN, 1979, 164 p.

The following two publications are available free from ESCS Publications, Room 0054-5, USDA, Washington, D.C., 20250.

Another Revolution in U.S. Farming? Lyle P. Schertz, December 1979, 445 p.

Measurement of U.S. Agricultural Productivity – A Review of Current Statistics and Proposals for Change. Technical Bulletin No. 1614, February 1980, 51 p.

Estimates of Regional Shipments and Supply Elasticities of Primary Commodities in Canada. Jane Ramin and Tim Hazledine, Discussion Paper 140, December 1979, 43 p. *Available free from the Council Secretary, Economic Council of Canada, P.O. Box 527, Ottawa, Ontario, K1P 5V6.*

A Guide to Land Purchases. Royal Bank of Canada, 1979, 15 p. *Available free from the Manager, 35th Floor, West Wing, Head Office, Royal Bank Building, Montreal, Quebec.*

Handling and Transportation of Flowers, Fruit and Vegetables in Alberta. G. Nabi Chaudhary, December 1979, 154 p. *Available free from the Production Economics Branch, Economic Services Division, Alberta Agriculture, 9718 - 107 Street, Edmonton, Alberta, T5K 2C8.*

Inventory of Canadian Agricultural Research 1978-1979. 536 p. *Available from the Canadian Agricultural Research Council, Room 1133, K.W. Neatby Building, Central Experimental Farm, Ottawa, Ontario, K1A 0C6.*

List of Available Agricultural Economics Publications from Cornell University. C.A. Bratton and M. Voorkeis, November 1979, 60 p. *Available free from the Department of Agricultural Economics, New York State College of Agriculture and Life Sciences, Ithaca, N.Y., 14853.*

Trade Realities in Canada and the Issue of Sovereignty Association. Government of Canada, 1978, 96 p. *Available free from the Canadian Unity Information Office, P.O. Box 1986, Station B, Ottawa, Ontario, K1P 6G6.*

IN REPLY

We appreciate your letters and comments on articles in Canadian Farm Economics. Let us know if you think a subject deserves an article and we shall try to accommodate you.

When forwarding your "In Reply" or letter indicate if we may publish your comments in a subsequent issue.

Ralph Russell, retired U.S. government economist, 2930 Legation St., N.W., Washington, D.C., 20015, wrote us an interesting letter about our October issue. He "found the article on the trade agreements *(J.S. Lohoar)* very informative, and learned more about oilseeds and their products *(J.W. Duncker)*. I know something about oilseed meal in dairy rations through having been a DHIA milk tester in Vermont and New York." Mr. Russell, having hailed from Truro, went on to tell us about some of his experiences as an agricultural economist in the thirties in Nova Scotia. He would particularly like to see an article on the "adventure of starting tobacco production in the Maritimes." However, Nelson Longmuir of our Special Crops Section, replied that a fine historical study on tobacco has already been done in Lyle Tate's "Tobacco in Canada," sponsored by the Ontario Flue-Cured Tobacco Growers' Marketing Board in 1968.

B. Heidenreich, regional policy planner, R.R.#1, Fraserville, Ontario, K0L 1V0, liked W. Darcovich and D. Leung's "Low Income Farm Families in 1976" in our October issue. He found the appendix most useful as well.

Chol-Soo, Lee, First Secretary, Korean Embassy, Suite 608, 151 Slater, Ottawa, Ontario, K1P 5H3, liked J.S. Lohoar's article, "The Multilateral Trade Negotiations

and Canadian Agriculture," in our October issue, and Soe Lin's "Prospects for Expanding Canada's Agricultural Exports to East Asia" in our December issue.

Sam G. Reimche, grain farmer, P.O. Box 264, Leader, Saskatchewan, S0N 1H0, had the following extensive comments on "An Economic Assessment of Dryland Cropping Programs in the Prairie Provinces: Income Variability," by R.P. Zentner *et al.* in our December issue.

"As a vocational farmer I am having difficulty in grasping the main thrust of your article on the variability of income in dryland prairie farming. However, you and I may be seeing it from different prospectives. Perhaps your readership dictates a detached, impersonal, calculation of large areas in general where formulas can be applied with relative accuracy. In my case, though, I see it as a very personal concern for a specific farm at a specific time, which directly affects how much money I will have in the next year, or even for years to follow.

The subject of income, variable or not, is not an easy subject for the farmer to grasp. The term "income" by itself is different things in different situations. The farmer has no income in the sense that a labourer or a professional is paid a sum for work or a service rendered. Income to the farmer is the money he feels he can use on himself that was brought in by selling what grew, after paying for current expenses and holding some back for future expenses. You can readily see from such a vague statement that a farmer rarely attempts to ascertain his income.

Because income is derived from selling what grew, I would like to get closer to the selling aspect. The variables of producing are dictated largely by the environment (rain, disease, insects, etc,) which are easily documented and predicted, which in effect makes them a non-variable. The farmer takes yield variability into account and treats it as a non-variable. The money he gets in selling is not predictable and so the farmer treats it as his main variable.

In Western Canada a situation has developed since WW II whereby we aren't able to sell all that we can grow. Because of this farmers are trying other crops in the hope that they can be sold. This is making for a lot of variability in income. I feel this is the main cause in unpredictable income. If our handling and transport system could move all the grain (wheat) that could be grown, the production of other crops and even livestock would be very small, and because the world price for wheat is very stable the income would be stable too. Wheat is still the crop Western Canada grows best with the least risk.

In support of my contention that the crop can't be moved, let me refer you to Canada Grains Council Statistical Handbook 1979, page 28, 'stocks at July 31.' You will see that the amount held over at the end of the year is sometimes equal to the production (page 9) of that year. What a ridiculous situation! Translating this into my own situation, I had 25% of my 1978 crop on hand when I started to harvest in 1979 and I know that I will have 50% of my 1979 crop on hand when I start harvesting in August 1980 – and I farm in the Brown Soil zone which normally yields the least on the prairies.

I trust this brief exchange has been of interest to you." *(Editor's note: the authors' reply will be in the next issue of CFE.)*

IN REPLY TO AUTHORS AND EDITORS REGARDING APRIL 1980 *CANADIAN FARM ECONOMICS*

I have read one or more of the following articles:

(1) A History of Agriculture Canada's Economic Branch, 1929-79
(2) Development of Agricultural Economics as a Discipline in Canada
(3) Developments in Canadian Agricultural Policy, 1929-79

1. My comments are on article number (1) (2) (3).
2. On a scale of one to ten how useful was this article to you?

   not useful ________________________________ very useful

   1 2 3 4 5 6 7 8 9 10

3. Why?

4. How useful was the whole issue to you?

5. Do you have any suggestions or questions on the contents of this issue?

My comments may ( ) may not ( ) be used in a future issue of this publication. (A copy of your comments will be forwarded to the author.)

NAME (Mr., Ms., or Dr.) ________________________________ Occupation ____________________
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Please return the above to:

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Information Services
Agriculture Canada, Sir John Carling Building
OTTAWA, Ontario
Canada
K1A 0C5

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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CANADIAN FARM ECONOMICS

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Fred O'Riordan

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Agriculture Canada

HON. EUGENE WHELAN, MINISTER – GAÉTAN LUSSIER, DEPUTY MINISTER

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Letters from readers: Letters are encouraged and should be addressed to the editor. Comments and suggestions are useful to editors and authors for effective two-way communication. Edited letters will be used in CFE with the writer's permission.

AN ECONOMIC EVALUATION OF ALTERNATIVE PROGRAMS TO CONTROL BRUCELLOSIS IN CANADIAN CATTLE

Fred O'Riordan*

The three papers in this special issue are excerpted from a benefit-cost analysis conducted by Agriculture Canada in 1979 to evaluate alternative program approaches to control or eradicate brucellosis in Canadian cattle. The first article provides a brief overview of benefit-cost analysis, including an explanation of some of its uses and limitations. The second and third papers examine and quantify two classes of benefits expected to result from an effective control program – benefits from a reduction in the prevalence of undulant fever in humans, and benefits from a reduction in the risk of trade sanctions being imposed by foreign countries against the importation of Canadian cattle.

In this context, four alternative control programs are evaluated: 1. test and slaughter, 2. test and slaughter with adult vaccination, 3. the present program, and 4. herd depopulation. The first program involves continuous monitoring of cattle herds, by various means, and the slaughtering of reactor animals found during herd tests. Program two includes vaccination of adult cattle in affected herds as an added preventive measure. The present program is a combination of programs one and four. Program four involves the testing of herds as under program one, and slaughtering of an entire herd if more than a specified proportion is found to be infected.

Program costs are not examined here, although they were estimated in the benefit-cost analysis. In that analysis, any of the four program alternatives was shown likely to generate large net social benefits. The herd depopulation program generated the highest expected net benefits, followed closely by the present program.

METHODOLOGY: THE USE OF BENEFIT-COST ANALYSIS

INTRODUCTION

This paper provides a brief overview of benefit-cost analysis, including an explanation of its main elements, its uses and limitations, and how its results should be interpreted.

Benefit-cost analysis is an economic technique used to systematically and consistently evaluate and rank alternative public sector investment projects or programs in terms of their impact on the welfare of society. This is done by attempting to identify and measure, in monetary terms, the flows of costs and benefits generated by alternative programs during a specific period.

Benefit-cost analysis facilitates the allocation of scarce resources to those uses which indicate the greatest potential returns to society. To assess whether or not a given program is worth doing, the resources necessary to implement and continue the program are compared with the improvement in the welfare of society that is likely to result. If the value of the resources is less than

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that of the benefits, the program may be judged socially and economically beneficial, and given the availability of funds and the absence of alternatives yielding higher net social benefits, the program may be undertaken. In addition to deciding whether or not a program is simply worth doing, benefit-cost analysis is also useful in choosing the best program from various alternatives which are designed to achieve a common objective. This is the most popular application of the technique.

ALLOCATIVE VERSUS NON-ALLOCATIVE EFFECTS

An important distinction must be made between those effects of public programs which increase total production and consumption opportunities in the economy, and those whose impact is to redistribute such opportunities from one group or region in the country to another. The effect of many government programs is not exclusively to increase global production possibilities or to redistribute them, but some combination of the two. The traditional focus of benefit-cost analysis is on the first type of impact, known as the efficiency or allocative impact of a program.

The second type of impact, which may be termed the non-allocative impact of a program, is not amenable to conventional benefit-cost analysis. (Although much work has been done on integrating the efficiency and equity effects of public-sector projects in a benefit-cost framework, this is beyond the scope of the present paper.) In benefit-cost analysis it is important to distinguish between allocative and non-allocative effects because allocative effects involve real resource costs or benefits that should be included in the analysis, whereas non-allocative effects do not.

An example from the present study dealing with brucellosis eradication may illustrate this point more clearly. One important element of the government's present brucellosis control program is to compensate producers, to a specified maximum amount per head, for cattle ordered destroyed under the Animal Disease and Protection Act. It might appear reasonable to include such expenditures as part of the control program's social cost. However, this would be improper because compensation is merely a transfer payment from one group in society (general taxpayers) to another (owners of destroyed animals). It does not affect the economy's production possibilities, but it does alter society's income distribution. If compensation were included as a cost of the present program it would also have to be included as a benefit to the fund recipients, and the two items would therefore offset and cancel each other. The program's true social cost is simply the real resource cost the program entails, while the main social benefit is the increased value of cattle production associated with a reduction in the prevalence of the disease. (Other social benefits are the topics of the following two papers.) The fact that compensation is paid is irrelevant from an allocative point of view, although it is obviously not inconsequential to either the owners of diseased animals or to the government.

SOCIAL BENEFITS AND COSTS

Two important differences exist between social benefit-cost analysis and private-sector financial analysis. These relate to the way in which benefits and costs are defined and measured.

BENEFITS AND COSTS

Definition

In choosing an appropriate investment program, a private decision-maker tries to achieve an objective such as the maximization of a company's profits or the financial returns to its shareholders. On the other hand, most would agree that the objective of a government is to maximize its constituents' welfare, given some fixed allocation of funds determined by the budgetary process. Whereas the private decision-maker would only include as benefits or costs of an investment program those effects which add to or subtract from its profitability, the government must take into account any additional external effects of its programs.

One example of such an external effect is that of an electrical generating plant which emits some type of pollution into the environment. The plant could be operated by a private firm or by a government-owned corporation. In evaluating the desirability of constructing such a plant, a private firm would not consider the potential damage resulting from pollution in its cost calculations (unless it were charged for polluting the environment). However, since pollution reduces the welfare of society-at-large and since government is concerned with maximizing society's welfare, damage caused by the pollution emitted should be included as a cost in calculating the desirability of a government-sponsored generating station.

This is only one type of situation in which the definition of private and social costs or benefits may differ. There are many instances, other than the presence of external effects, when this may occur.

Measurement

In addition to differences of definition, there are also sometimes differences in the way in which relevant benefits and costs are measured or valued in public- versus private-sector financial analyses. A good's value, or alternatively, the cost of a good, either produced as an output or consumed as an input in a public or private project, is usually assumed to equal its exchange value or the price determined for it elsewhere in the economy by normal market forces. Private benefits and costs are always estimated with reference to observed or projected market prices. However, under certain circumstances, a good's market price does not reflect its social worth or the opportunity cost of resources used in its production. These situations may arise, for example, when there are market distortions such as monopolies which drive prices above competitive levels through supply restrictions, when there are taxes or subsidies on inputs or outputs, or when some resources are unemployed. Market prices are still used in such instances in private-sector analyses because they represent the cost of resources to the firm. For public-sector analyses, however, it is necessary to adjust the observed market prices to compensate for these distortions. The adjusted or shadow prices provide a more accurate measure of the good's true opportunity cost to society.

Finally, public and private analyses differ in that the government often provides goods that are not normally bought or sold in a market. For example, there is no market to indicate the value people place on many publicly-provided goods and services such as parks, museums, lighthouses, and police protection which are financed through taxes and have no user charges. For these items, close substitutes may be identified which are produced and sold in the private sector. Alternatively, it may be possible to determine people's willingness to pay for these goods by, for example, conducting a survey of the potential beneficiaries.

THE SOCIAL RATE OF DISCOUNT

Whether public or private, most investments yield benefits and incur costs in the future as well as in the present. The time stream of costs and benefits can vary considerably among projects. Society differentiates between benefits and costs which occur in the future and in the present. Each dollar of benefits or costs in any future period is valued less highly than each dollar of benefits or costs occurring in the present. For this reason, costs incurred and benefits derived at different periods must be reduced to some common point in time, usually the present, before they can be compared with each other. In benefit-cost analysis, a discount rate is used to reduce future benefits and costs to present values. The exact relationship between the value that society places on a dollar's worth of expenditure in future, compared with current periods is reflected by the social rate of discount.

Economists do not agree on the appropriate social rate of discount. Two theoretical approaches exist: the opportunity cost of capital and the social rate of time preference.

Adherents to the former theory argue that to justify a public sector program, benefits and costs should be discounted at a rate equivalent to the rate of return to investment in the private sector. This is because the opportunity cost of increased investment in the public sector is reduced investment in the private sector.

Supporters of the latter theory argue that individuals are willing to lend funds to the government at much lower rates than this through the purchase of government bonds, and that the benefits and costs from public expenditures should be discounted at this rate because it is the cost of funds to the government and the rate at which society is willing to defer current consumption in exchange for increased consumption in future periods.

Under certain rigid conditions, each theory would yield an equivalent social discount rate. In reality, however, many factors prevent this from happening. Much of the recent theoretical work in this area has involved an attempt to integrate or synthesize the two approaches. In practice this basically involves calculating the social opportunity cost of a given government expenditure by estimating the opportunity cost of investment and consumption in various non-government sectors of the economy, then weighting them in relation to the proportion of funds that was bid away from that sector to finance the government activity.[1]

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[1] See, for example, Glenn P. Jenkins, *Capital in Canada: Its Social and Private Performance, 1965-1974*, (Ottawa: Economic Council of Canada, Discussion Paper No. 98, October 1977). Jenkins estimates that the real social rate of discount in Canada is 10.02 percent. For a good theoretical discussion of the social discount rate see David Burgess, "The Social Discount Rate for Canada: Theory and Measurement" (Ottawa: Special Studies Branch, Economic and Policy Analysis Sector, Energy, Mines and Resources Canada, 1980). Burgess concludes that the real discount rate is 7-8 percent.

In this study a real social rate of discount of 10 percent a year is used. This is consistent with a Treasury Board Canada recommendation that a real rate of 10 percent should normally be used in benefit-cost analyses performed by federal departments and agencies.[2]

THE USE OF SUMMARY STATISTICS

When the benefits and costs expected to result from investing funds in a given program are properly identified, measured, and discounted to the present, they must be compared with each other to determine whether or not the program should be implemented. Several alternative summary statistics, or investment criteria, can be used for this. The most common are net present values, benefit-cost ratios, and internal rates of return. Given the availability of funds, programs which are not mutually exclusive should generally be undertaken if they yield positive net present values, benefit-cost ratios exceeding unity, or internal rates of return greater than the social rate of discount.

The net present value of a program is determined by subtracting the present value of program costs from the present value of benefits. A program's net present value may therefore be expressed as follows:

$$\sum_{t=o}^{n-1} \frac{(B-C)_t}{(1+r)^t} = (B-C)_o + \frac{(B-C)_1}{(1+r)} + \ldots + \frac{(B-C)_{n-1}}{(1+r)^{n-1}} ;$$

where B_t = program benefits in year t,
C_t = program costs in year t, and
r = social rate of discount.

One can find the benefit-cost ratio by dividing the present value of a program's benefits by the present value of its costs:

$$\frac{\sum_{t=o}^{n-1} \frac{B_t}{(1+r)^t}}{\sum_{t=o}^{n-1} \frac{C_t}{(1+r)^t}}$$

The internal rate of return is the rate which equates the present value of benefits and the present value of costs:

$$\sum_{t=o}^{n-1} \frac{B_t}{(1+i)^t} - \frac{C_t}{(1+i)^t} = 0 ,$$

where i = internal rate of return.

Each of the above summary statistics can be used to determine whether or not a given program is economically worthwhile and which program alternative is preferred. Each statistic yields slightly different information and none is unequivocally superior to the others in all circumstances, although net present value is the most commonly recommended. It is normally advisable to calculate several summary statistics when evaluating a given program or set of program alternatives to view the program or programs from more than one perspective. However, there are some situations in which the use of any two of the statistics will produce conflicting rankings of programs.

One such situation, encountered when using net present values and benefit-cost ratios, is illustrated in Table 1 which has five mutually-exclusive projects, A to E, to be evaluated and ranked. For simplicity it is assumed that each project would entail capital costs in year zero with no additional operating costs in subsequent years. The most preferred project is project A using the net present value criterion, but project C with the benefit-cost ratio criterion. Which criterion is correct? Under most circumstances, the relevant criterion is the maximization of net present value because this ensures the selection of that project which will contribute the greatest increase to society's total welfare. The benefit-cost ratio gives, for each project, the benefits per dollar of cost, and it can therefore be useful in determining which projects yield the greatest marginal benefits (benefits per dollar expended) to society.

In certain circumstances this property of benefit-cost ratios can be useful. For example, if there is a binding constraint on the availability of capital then it is proper to judge projects by their benefit-cost ratios, selecting each marginal project until the available capital stock is depleted. Refering again to the example in Table 1, assume that the projects listed are independent so that any or all of the projects may be undertaken, but the stock of available capital is limited to $125,000. Using net present value as the investment criterion, projects A and C would be completed yielding net social benefits of $75,000 and exhausting the capital budget. However, using the benefit-cost ratio criterion, projects C, D, E, and B would be carried out yielding net benefits of $95,000. So in this particular circumstance, the benefit-cost ratio is the superior investment criterion because

[2] See Treasury Board Secretariat, *Benefit-Cost Analysis Guide* (Ottawa: Supply and Services Canada, 1976), p. 26 and Treasury Board Canada, *Administrative Policy Manual*, Chapter 490 "Socio-Economic Impact Analysis" (Ottawa: Supply and Services Canada, 1979), p. 31.

TABLE 1. CONFLICTING RANKINGS USING NPV AND B/C RATIO CRITERIA[a]

Project	Initial Cost	Discounted Benefits	NPV	B/C Ratio	Ranking by NPV	Ranking by B/C Ratio
	–	$'000	–			
A	100	140	40	1.4	1	5
B	50	75	25	1.5	3	4
C	25	60	35	2.4	2	1
D	25	45	20	1.8	4	2
E	25	40	15	1.6	5	3

[a]NPV = net present value and B/C = benefit cost.

the mix of projects selected using it yields a greater total benefit to society than the projects selected using the net present value criterion.

Similar examples could be constructed to illustrate potential conflicts in rankings when using either net present values or benefit-cost ratios versus internal rates of return as investment criteria. However, practice cases in which conflicts arise are quite rare, and normally all summary statistics yield consistent project rankings. As a general rule the maximization of net present value should be chosen as the relevant investment criterion. In the brucellosis benefit-cost analysis, both a net present value and a benefit-cost ratio are calculated for each program alternative.

SUMMARY

Effects of a public program that alter the way in which society's resources are allocated among competing ends are called allocative effects; those which change the distribution of income in society are termed non-allocative effects.

Benefit-cost analysis is useful as an evaluation technique in assessing a program's impact on resource allocation.

The definition and measurement of benefits and costs sometimes differ between a government agency and private firm's evaluation study.

There is a need for and an appropriate value for a social rate of discount. A real discount rate of 10 percent a year is recommended for use in benefit-cost analyses performed by federal departments and agencies.

Of several summary statistics available to interpret the results of a study, net present values and benefit-cost ratios are used in the present study.

For a more extensive treatment of this subject the reader is referred to one of the selected references which follow.

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BENEFITS FROM A REDUCTION IN THE PREVALENCE OF UNDULANT FEVER IN HUMANS

INTRODUCTION

Brucellosis is a contagious disease which can be transmitted from animals to humans. In humans the disease is known by several names in addition to brucellosis, the most common of which is undulant fever.[1] Undulant fever is a relatively uncommon disease sometimes contracted by persons closely associated with the handling of diseased cattle. These people can be veterinarians, packinghouse workers, and cattle producers themselves. The disease is seldom fatal.[2]

If it is assumed that a direct relationship exists between the prevalence of brucellosis in cattle and in humans, then one benefit of a control program which lowers the prevalence of the disease in cattle would be a reduction in the costs associated with the disease in humans. This paper calculates the expected value of such benefits for four program alternatives during a 20-year period. For any given program the expected value of benefits would be equivalent to the present value of the disease's cost in the absence of any program minus the present value of such cost in the presence of that program (given by the per case cost multiplied by the difference between the number of cases expected to occur in the absence and in the presence of the program in each year).

In the next section the per case cost of undulant fever is categorized and quantified. The annual prevalence and expected number of cases are then estimated for each type of program for the study period. The fourth section reports the expected benefits attributable to each program. A summary of the analysis concludes the paper.

COST PER CASE OF UNDULANT FEVER

The per case cost of undulant fever may be divided into direct and indirect costs. The direct cost is the treatment cost of the disease. This consists of the costs of medication, the services of medical doctors, and hospitalization, if necessary. The indirect cost is the value of lost production associated with sick leave. Other possible cost categories are not quantified here. These might include the psychic or intangible costs relating, for example, to the pain and suffering of victims, and the cost of a reduction in the productivity of workers who may have unknowingly contracted the disease and remain on the job.[3]

The marginal (per case) cost of the disease is determined by calculating and then summing the direct and indirect cost components. The various cost categories are explained briefly in the following subsections.

Direct Cost

Medication Costs

It is assumed that patients with standard symptoms of the disease who do not require hospitalization are treated with an antibiotic for three weeks. The cost of the drug for this period is $8.50. Severe cases requiring hospitalization are also treated with the same drug, but are given an injection treatment as well for two weeks. The cost of this additional drug is $3.90 for the two-week treatment. Therefore, the drug cost for a hospitalized patient is $12.40.

Cost of Physicians' Services

It is assumed that a patient who does not require hospitalization needs one initial visit, plus one subsequent visit with a general practitioner.

In cases of prolonged disability, a patient is referred to a specialist in internal medicine for a consultation visit. A report from the specialist is then given to the general practitioner who continues to treat the patient.

[1] *Webster's Third New International Dictionary* defines undulant fever as "a disease of man of sudden or insidious onset and long duration characterized by great weakness, extreme exhaustion on slight effort, night sweat, chilliness, remittant fever, and generalized aches and pains and acquired through direct contact with infected animals or animal products."

[2] The last reported death in Canada occurred in Ontario in 1971; previously there were deaths in Quebec and Alberta in 1962.

[3] The true cost of the disease is probably understated for these reasons. In addition, the medical profession generally agrees that many cases of undulant fever are:

- not diagnosed because victims dismiss symptoms as ordinary fever, headache, aching joints, or depression;
- misdiagnosed (as influenza, arthritis, etc.) by doctors unfamiliar with the disease; and
- diagnosed but not officially reported by the doctor because of the paperwork involving the required documentation for the Annual Report of Notifiable Diseases.

It is assumed that a patient requiring hospitalization goes through three visits with various doctors. The first visit is a complete examination by a general practitioner; the second is a consultation with a specialist in internal medicine; the third is a follow-up with the general practitioner once the report is received from the specialist.

Hospitalization Costs

Severe cases of undulant fever require hospitalization. The per case cost of hospitalization comprises the daily cost of hospitalization times the average number of days hospitalization required per case.[4]

Indirect Cost

Lost Production Costs

An indirect social cost of undulant fever is the current production loss in the economy resulting from infected workers being absent from work for diagnosis, treatment, and recuperation. The conventional way of estimating such losses is to calculate the loss of the infected workers' gross earnings as a proxy for value-added.[5] Some workers may receive full or partial compensation for lost wages through Workmen's Compensation or a private insurance scheme. However, such compensation merely represents a transfer of income from one group to another and does not reduce the resource cost due to lost production.

It is also assumed that the output of each marginal worker infected cannot be maintained without cost in his absence. This might be possible, for example, if there were significant numbers of unemployed in the worker's profession or trade, or if the worker were paid a salary or wage greatly in excess of his contribution to output.[6]

Canadian morbidity statistics do not distinguish between cases according to occupation. It is assumed that the distribution by occupation would parallel that of the United States, given in Table 1 for 1977.

TABLE 1. CASES OF UNDULANT FEVER BY OCCUPATION, UNITED STATES, 1977

Occupation	Number of Cases	Proportion of Total
Packinghouse Employee	102	.723
Livestock Producer	23	.163
Government Inspector	7	.050
Veterinarian	2	.014
Other	7	.050
Total	141	1.000

The U.S. distribution and the average hourly wage for each occupation yields the weighted average hourly wage per case (Table 2).

The weighted average wage of $6.72 an hour means a weekly loss of $252.00 for each case (based on a 37.5-hour workweek). The average disability period per case is assumed to be four weeks.[7]

Total Cost

The total cost per case is found by adding each of the foregoing cost components. This is done by province in Tables 1 through 5 in the appendix. The per case cost is given separately for hospitalized and non-hospitalized cases. The national cost per case is then determined in Table 6 by weighting the per case provincial costs by the proportion of cases which have historically occurred in that province. The weighted average national cost is $3,261 for each hospitalized and $1,040 for each non-hospitalized case.

[4] All costs in this paper are expressed in constant (1977) dollars. The cost of hospital treatment has been increasing relative to the general level of costs in the rest of the economy during the past decade. If this were to continue, the real value per case averted would increase during the period of the analysis. This would imply that the benefits as calculated here would understate the true benefits of any effective control program. For this reason and those mentioned in footnote 3, the benefits quantified here should be considered conservative estimates of the true benefits of a program.

[5] There are approaches other than the one used in this paper to place a value on human health. This area of economic analysis is controversial and there are differences of opinion concerning the most appropriate method to be used in particular circumstances. However, these differences tend to be minimized the less serious the illness or accident, and, as a consequence, the lower the risk of dying. Few cases of undulant fever result in death or prolonged disability, so the disease's cost can consist of the direct treatment cost and the opportunity cost of foregone output, both of which are quite amenable to measurement. While other cost categories are recognized, such as pain and suffering, no attempt has been made to quantify them here.

[6] In more formal terms, the price of the worker's labor is assumed to equal the value of his marginal product.

[7] Dr. Dorothy Burton of the Industrial Diseases Section of the Workmen's Compensation Board of Ontario stated that, from her experience, a two- to six-week disability period can be expected from undulant fever.

TABLE 2. WEIGHTED AVERAGE HOURLY WAGE PER CASE OF UNDULANT FEVER, CANADA, 1977

Occupation	Hourly Wage	Distribution by Occupation	Weighted Hourly Wage
	– $ –		– $ –
Packinghouse Employee	7.00	.723	5.06
Livestock Producer	5.00	.163	.81
Government Inspector	7.70	.050	.38
Veterinarian	11.50	.014	.16
Other	6.25	.050	.31
Total	–	–	6.72

DETERMINATION OF PREVALENCE LEVEL BY PROGRAM

In addition to the cost per hospitalized and non-hospitalized case, it is necessary to predict the prevalence level of the disease (number of cases a year divided by total population), and from this the number of hospitalized and non-hospitalized cases a year, to calculate the benefits of each program alternative. The forecast prevalence levels are based on the fundamental assumption that there is a direct causal relationship between the prevalence of brucellosis in cattle and that of undulant fever in humans. This hypothesis is supported by the strong historical correlation between the two (Figure 2).

Using generalized least squares,[8] the relationship between the actual past prevalence of the disease in humans and cattle for the period 1960-77 is estimated to be:

$$Y_t = \underset{(0.009)}{0.00001} + \underset{(5.116)}{0.19307}\, X_{t-1}\,, \qquad \bar{R}^2 = 0.55 \qquad \text{D-W} = 1.38$$

where Y_t = prevalence in humans in year t and
X_{t-1} = prevalence in cattle in year t-1.
(Figures in parentheses are t statistics.)

It is assumed that this relationship holds for the 1977-96 period being analyzed here. The expected future prevalence of brucellosis in cattle is forecast elsewhere in the benefit-cost study for each program scenario using a triple-binomial computer model to simulate the spread of the disease. When substituted into the foregoing equation, these values yield estimates for the annual expected prevalence in humans. The number of cases by program is determined by multiplying the expected prevalence level for a given year by the forecast population for that year.[9]

The annual number of cases is composed of the number of hospitalized and the number of non-hospitalized cases. Although statistics on the number of hospitalized cases are very reliable, those on the total number of cases are much less credible because of the factors outlined in footnote 3. However, practitioners do have a reasonable estimate of the hospitalization rate in cases of undulant fever, i.e. the proportion of total cases which require hospitalization.[10] For these reasons the number of non-hospitalized cases is estimated for 1977 and subsequent years as the number of hospital-

[8] Specifications fitted using ordinary least squares yielded error terms which were serially dependent.

[9] Obtained from Statistics Canada, *Population Projections for Canada and the Provinces, 1976-2001* (Ottawa: Statistics Canada, Catalogue No. 91-520 Occasional, February 1979).

[10] Several practitioners with experience in diagnosing and treating undulant fever were contacted to obtain an estimate of the hospitalization rate among disease victims. Each was asked to state the number of cases diagnosed in the last five years and the number requiring hospitalization. The results by respondent were as follows:

Practitioner	Diagnosed	Hospitalized
Dr. Edwards, Medical Officer of Health (M.O.H.), Peterborough Co., Ontario	7	2
Dr. Hodgkinson, M.O.H., Brockville, Ontario	20	2
Dr. Huntington, M.O.H., Kitchener-Waterloo, Ontario	5	1
Dr. Mikel, M.O.H., Cobourg, Ontario	7	1
Dr. C. Murphy, Winnipeg, Manitoba	45	0
Dr. S. Tamblyn, M.O.H., Stratford, Ontario	8	2
Sample Average	0.087	

Other medical authorities contacted, including Dr. Dorothy Burton of the Ontario Workmen's Compensation Board and Dr. Bill Keith of the Epidemiology Section of the Ontario Ministry of Health, agreed that 0.10 is a reasonable estimate. A hospitalization rate of 0.10 is assumed in this paper.

ized cases divided by the hospitalization rate minus the number of hospitalized cases.[11]

Because undulant fever is a persistent disease there is a high frequency of recurrence for a given individual. The number of hospitalized cases annually reported by Statistics Canada refers to the number of hospital separations, or patients discharged from hospital, without distinguishing between new and recurring infections. For example, an individual who received hospital treatment for the disease in 1977 and had a recurrence later the same year would be reported as two separate cases. For this reason, no explicit allowance is made in the cost calculations for recurrence because it has already been allowed for in the reporting procedures. To include a recurrence factor would constitute double-counting and would overstate the true prevalence of the disease and the true cost of treatment and lost production.

The forecast prevalence levels and number of hospitalized and non-hospitalized cases are in Tables 7 and 8 of the appendix for the no program and four program alternatives.

BENEFITS BY PROGRAM

The annual social benefits attributable to a given brucellosis control program are equal to the savings, in terms of treatment cost and foregone output, that are expected to result from the program, i.e. the difference between the cost that the disease would be expected to incur if there were no control program, and the (smaller) cost expected under that program. These benefits are expressed by multiplying the cost per hospitalized and non-hospitalized case by the difference between the number of cases in the absence of any program and in the presence of each program. The annual benefits are then discounted in a manner

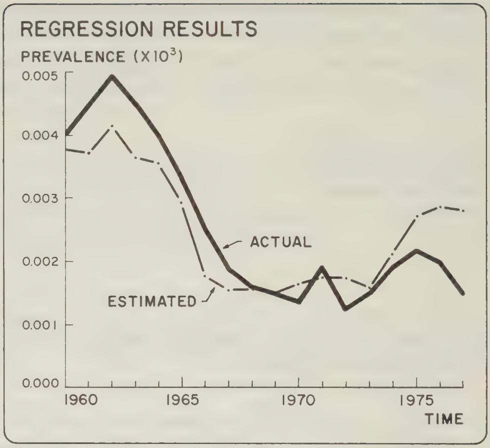

Figure 1

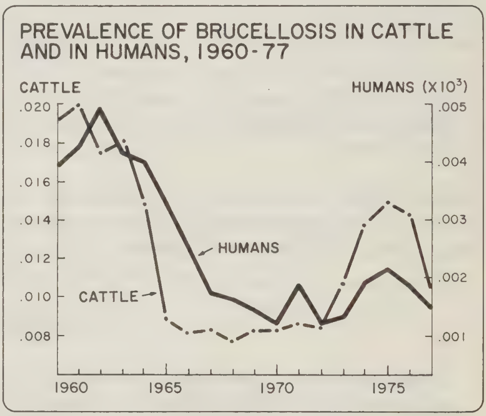

Figure 2

consistent with that used elsewhere in the benefit-cost study using a real social discount rate of 10 percent.[12]

The present value of expected benefits for each program alternative is in Table 8. There is relatively little variation in the results by program. Benefits range from a low of $35.10 million for the test and slaughter alternative, to a high of $36.90 million for the herd depopulation alternative. Expected benefits from the other two alternatives are $36.61 million for the present program and $36.56 million for the test and slaughter with adult vaccination alternative. Although there is little difference in the absolute value of expected benefits

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[11] Given that $C_{NH} = TC - C_H$ and $R_H = \dfrac{C_H}{TC}$,

it follows by substitution that $C_{NH} = \dfrac{C_H}{R_H} - C_H$,

where TC = total cases,
C_H = hospitalized cases,
C_{NH} = non-hospitalized cases, and
R_H = hospitalization rate.

by program, if each program were ranked relative to the present program instead of the no program alternative, differences in the relative efficacy of each program would be more apparent. Such a comparison would indicate, for example, an increase in benefits of \$295,877 in moving from the present program to a herd depopulation program, and a benefit decrease of \$1,507,068 from switching to a test and slaughter alternative. To properly evaluate each program would require a comparison of the relative costs of each program as well as the relative benefits. Such a comparison is beyond the scope of this paper.

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[12] $$PV(SB) = \sum_{t=0}^{19} SC_t(1+r)^{-t}$$

$$= SC_o + \frac{SC_1}{(1+r)} + \frac{SC_2}{(1+r)^2} + \ldots + \frac{SC_{19}}{(1+r)^{19}},$$

where PV(SB) = present value of social benefits,
SC_t = social benefits in year t,
r = real social discount rate of 0.10, and
t_o = time period t (1977).

SUMMARY OF THE ANALYSIS

This analysis measured the benefits that a given brucellosis control program for cattle might have in terms of its impact on the prevalence of undulant fever in humans. The social cost per case of undulant fever was calculated in 1977 dollars and a direct functional relationship between the prevalence of the disease in cattle and in humans was assumed and estimated. This relationship, based on historical prevalence levels, was then used in conjunction with forecast prevalence levels of brucellosis for four program and one no program scenarios to predict the annual future prevalence of undulant fever for the period 1977-96. These prevalence levels were multiplied by population forecasts to determine the number of cases a year for each program alternative. Multiplication of the predicted number of cases by the previously-calculated cost per case of the disease yielded the disease's expected social cost for each alternative. The social benefits of a given program were then obtained as the difference between the expected cost of the disease in the absence of any program (the no program alternative) and the expected cost in the presence of the given program. The annual social benefits of each program were discounted at a real social discount rate of 10 percent and then summed to yield the present value of benefits by program.

The results of this analysis are used in an Agriculture Canada benefit-cost study in which each of the four program alternatives is evaluated in terms of its overall benefits and costs.

APPENDIX

TABLE 1. COST OF PHYSICIANS' SERVICES PER CASE (1977 DOLLARS)

Province	Complete Examination by a General Practitioner	Subsequent Visit to a General Practitioner	Consultation with a Specialist in Internal Medicine	Cost of Physicians' Services per Hospitalized Case	Cost of Physicians' Services per Non-Hospital-ized Case
Nfld.	12.75	6.25	38.00	57.00	19.00
P.E.I.	15.66	6.35	40.90	62.91	22.01
N.S.	18.93	6.68	44.55	70.16	25.61
N.B.	14.50	6.30	39.10	59.90	20.80
Que.	15.68	7.50	35.25	58.43	23.18
Ont.	15.91	7.20	44.10	67.21	23.11
Man.	14.45	7.87	39.55	61.87	22.32
Sask.	14.68	6.15	41.50	62.33	20.83
Alta.	17.00	9.44	51.70	78.14	26.44
B.C.	21.50	9.04	62.70	93.24	30.54

TABLE 2. AVERAGE NUMBER OF DAYS HOSPITALIZATION PER CASE[a]

Province	1973	1974	1975	1976	Weighted Average 1973-76
Nfld.	0	13.00	–	–	13.00
P.E.I.	0	0	0	–	–
N.S.	0	0	14.00	–	14.00
N.B.	0	15.00	6.50	–	9.33
Que.	15.10	16.27	16.43	13.40	15.24
Ont.	10.74	17.75	16.97	9.82	14.03
Man.	2.00	11.67	0	9.40	9.92
Sask.	8.80	16.00	3.00	12.00	9.50
Alta.	20.00	18.00	16.40	9.00	15.82
B.C.	13.44	16.19	10.64	9.00	13.48

[a]0 indicates no cases reported; – indicates no data available.

Source: *Hospital Morbidity,* Statistics Canada, Catalogue No. 82-206 Annual.

TABLE 3. HOSPITALIZATION COST PER CASE (1977 DOLLARS)

Province	Average Days Hospitalization per Case[a] (1)	Total Cost per Patient-Day[b] (2)	Hospitalization Cost per Case (1) x (2)
Nfld.	13.00	164.58	2,139.54
P.E.I.	–	102.04	–
N.S.	14.00	142.58	1,996.12
N.B.	9.33	129.27	1,206.09
Que.	15.24	184.45	2,811.02
Ont.	14.03	155.14	2,176.61
Man.	9.92	143.87	1,427.19
Sask.	9.50	111.97	1,063.72
Alta.	15.82	140.75	2,226.67
B.C.	13.48	121.45	1,637.15

[a]Source: Table 2.

[b]Source: *Hospital Indicators,* Statistics Canada, Catalogue No. 83-001 Quarterly.

TABLE 4. TOTAL COST PER HOSPITALIZED CASE (1977 DOLLARS)

Province	Average Wage Loss	+	Cost of Medication	+	Cost of Physicians' Services	+	Cost of Hospitalization	=	Total Cost per Hospitalized Case
Nfld.	1,008.00		12.40		57.00		2,139.54		3,216.94
P.E.I.	1,008.00		12.40		62.91		–		–
N.S.	1,008.00		12.40		70.16		1,996.12		3,086.68
N.B.	1,008.00		12.40		59.90		1,206.09		2,286.39
Que.	1,008.00		12.40		58.43		2,811.02		3,889.85
Ont.	1,008.00		12.40		67.21		2,176.61		3,264.22
Man.	1,008.00		12.40		61.87		1,427.19		2,509.46
Sask.	1,008.00		12.40		62.33		1,063.72		2,146.45
Alta.	1,008.00		12.40		78.14		2,226.67		3,325.21
B.C.	1,008.00		12.40		93.24		1,637.15		2,750.79

TABLE 5. TOTAL COST PER NON-HOSPITALIZED CASE (1977 DOLLARS)

Province	Average Wage Loss	+	Cost of Medication	+	Cost of Physicians' Services	=	Total Cost per Non-Hospitalized Case
Nfld.	1,008.00		8.50		19.00		1,035.50
P.E.I.	1,008.00		8.50		22.01		1,038.51
N.S.	1,008.00		8.50		25.61		1,042.11
N.B.	1,008.00		8.50		20.80		1,037.30
Que.	1,008.00		8.50		23.18		1,039.68
Ont.	1,008.00		8.50		23.11		1,039.61
Man.	1,008.00		8.50		22.32		1,038.82
Sask.	1,008.00		8.50		20.83		1,037.33
Alta.	1,008.00		8.50		26.44		1,042.94
B.C.	1,008.00		8.50		30.54		1,047.04

TABLE 6. WEIGHTED AVERAGE COST PER CASE, CANADA (1977 DOLLARS)

	Weighted Average Cost per Case					
	Hospitalized			Non-Hospitalized		
Province	Cost Per Hospitalized Case	Proportion of National Cases	Weight in National Average	Cost Per Non-Hospitalized Case	Proportion of National Cases	Weight in National Average
Nfld.	3,216.94	.005	16.08	1,035.50	.005	5.18
P.E.I.	–	0	0	1,038.51	0	0
N.S.	3,086.68	.005	15.43	1,042.11	.005	5.21
N.B.	2,286.39	.02	45.73	1,037.30	.02	20.75
Que.	3,889.85	.30	1,166.96	1,039.68	.30	311.90
Ont.	3,264.22	.36	1,175.12	1,039.61	.36	374.26
Man.	2,509.46	.06	150.57	1,038.82	.06	62.33
Sask.	2,146.45	.07	150.25	1,037.33	.07	72.61
Alta.	3,325.21	.08	266.02	1,042.94	.08	83.44
B.C.	2,750.79	.10	275.08	1,047.04	.10	104.70
Canada Weighted Average			$3,261.24			$1,040.38

TABLE 7. PREVALENCE AND NUMBER OF CASES, ASSUMING NO PROGRAM

Year	Prevalence ($\times 10^3$)	Number of Cases	
		Hospitalized	Non-Hospitalized
1977	0.0016	38	342
1978	0.0023	53	477
1979	0.0024	58	522
1980	0.0029	70	630
1981	0.0038	92	828
1982	0.0053	131	1,179
1983	0.0078	194	1,746
1984	0.0113	284	2,556
1985	0.0154	392	3,528
1986	0.0196	503	4,527
1987	0.0231	600	5,400
1988	0.0257	674	6,066
1989	0.0274	727	6,543
1990	0.0286	764	6,876
1991	0.0293	790	7,110
1992	0.0298	809	7,281
1993	0.0301	825	7,425
1994	0.0302	834	7,506
1995	0.0306	851	7,659
1996	0.0308	863	7,767

TABLE 8. PREVALENCE, NUMBER OF CASES, AND EXPECTED BENEFITS
PART 1. TEST AND SLAUGHTER ALTERNATIVE

Year	Prevalence ($\times 10^4$)	Number of Cases		Present Value of Expected Benefits
		Hospitalized	Non-Hospitalized	
				– $ –
1977	0.0059	14	126	302,904
1978	0.0082	19	171	390,104
1979	0.0086	20	180	396,362
1980	0.0080	19	171	483,600
1981	0.0071	17	153	646,523
1982	0.0063	15	135	909,051
1983	0.0057	14	126	1,282,361
1984	0.0053	13	117	1,755,165
1985	0.0049	13	117	2,231,461
1986	0.0051	13	117	2,622,796
1987	0.0051	13	117	2,856,355
1988	0.0055	14	126	2,919,582
1989	0.0061	16	144	2,859,269
1990	0.0067	18	162	2,727,244
1991	0.0074	20	180	2,559,097
1992	0.0082	22	198	2,377,843
1993	0.0092	25	225	2,197,345
1994	0.0103	29	261	2,010,071
1995	0.0113	31	279	1,861,404
1996	0.0123	34	306	1,710,755
Total				35,099,292

TABLE 8. PREVALENCE, NUMBER OF CASES, AND EXPECTED BENEFITS PART 2. TEST AND SLAUGHTER WITH ADULT VACCINATION ALTERNATIVE

Year	Prevalence ($\times 10^4$)	Number of Cases: Hospitalized	Number of Cases: Non-Hospitalized	Present Value of Expected Benefits
				– $ –
1977	0.0051	12	108	328,146
1978	0.0051	12	108	470,419
1979	0.0030	7	63	531,960
1980	0.0016	4	36	625,835
1981	0.0015	4	36	758,588
1982	0.0013	3	27	1,003,091
1983	0.0011	3	27	1,360,728
1984	0.0011	3	27	1,819,931
1985	0.0009	2	18	2,296,226
1986	0.0007	2	18	2,681,675
1987	0.0007	2	18	2,909,881
1988	0.0007	2	18	2,972,666
1989	0.0007	2	18	2,915,570
1990	0.0007	2	18	2,785,738
1991	0.0007	2	18	2,618,920
1992	0.0007	2	18	2,438,271
1993	0.0007	2	18	2,260,519
1994	0.0007	2	18	2,077,490
1995	0.0007	2	18	1,927,234
1996	0.0007	2	18	1,776,792
Total				36,559,680

TABLE 8. PREVALENCE, NUMBER OF CASES, AND EXPECTED BENEFITS PART 3. PRESENT PROGRAM ALTERNATIVE

Year	Prevalence ($\times 10^4$)	Number of Cases: Hospitalized	Number of Cases: Non-Hospitalized	Present Value of Expected Benefits
				– $ –
1977	0.0059	14	126	302,904
1978	0.0053	12	108	470,419
1979	0.0038	9	81	511,098
1980	0.0024	6	54	606,870
1981	0.0013	3	27	767,208
1982	0.0009	2	18	1,010,928
1983	0.0005	1	9	1,374,976
1984	0.0005	1	9	1,832,885
1985	0.0005	1	9	2,302,114
1986	0.0003	0	7	2,689,293
1987	0.0003	0	7	2,916,806
1988	0.0003	0	7	2,978,961
1989	0.0001	0	3	2,922,619
1990	0.0001	0	3	2,792,146
1991	0.0001	0	3	2,624,745
1992	0.0001	0	3	2,443,567
1993	0.0001	0	3	2,265,333
1994	0.0001	0	3	2,081,866
1995	0.0001	0	3	1,931,213
1996	0.0001	0	3	1,780,409
Total				36,606,360

TABLE 8. PREVALENCE, NUMBER OF CASES, AND EXPECTED BENEFITS
PART 4. HERD DEPOPULATION ALTERNATIVE

Year	Prevalence ($\times 10^4$)	Number of Cases		Present Value of Expected Benefits
		Hospitalized	Non-Hospitalized	
				– $ –
1977	0.0059	14	126	302,904
1978	0.0013	3	27	573,682
1979	0.0005	1	9	594,543
1980	0.0002	0	6	659,076
1981	0.0001	0	3	790,938
1982	0.0001	0	3	1,024,664
1983	0.0001	0	3	1,380,339
1984	0.0001	0	3	1,837,761
1985	0.0001	0	3	2,306,546
1986	0.0001	0	3	2,691,057
1987	0.0001	0	3	2,918,410
1988	0.0001	0	3	2,980,419
1989	0.0001	0	3	2,922,619
1990	0.0001	0	3	2,792,146
1991	0.0001	0	3	2,624,745
1992	0.0001	0	3	2,443,567
1993	0.0001	0	3	2,265,333
1994	0.0001	0	3	2,081,866
1995	0.0001	0	3	1,931,213
1996	0.0001	0	3	1,780,409
Total				36,902,237

BENEFITS FROM A REDUCTION IN THE RISK OF EXTERNAL TRADE SANCTIONS

INTRODUCTION

Canada traditionally enjoys a large surplus in the international trade of live cattle for feeding and breeding purposes. An increase in the domestic prevalence of brucellosis could result in a reduction in Canadian exports.[1] The probability that exports would be reduced would be higher, the greater the increase in domestic prevalence. If there were no control program in Canada, it is probable that the prevalence of the disease would quickly reach a sufficiently high level to cause the governments of importing countries to impose restrictions banning the importation of Canadian cattle. Therefore, one of the benefits of any given control program is the avoidance of the social losses that would otherwise occur in the absence of any program.

This paper estimates the value of such benefits for several program alternatives. Since there is considerable uncertainty concerning the magnitude and timing of any trade ban in a given year, the expected value of the benefits of a particular program is equivalent to the value of the social losses that would occur in the event of a ban, multiplied by the difference between the subjective probability of a ban occurring in the absence of any program and the presence of that particular program.

The following section presents the maximum potential losses in welfare from a total trade ban calculated for each year of a 20-year period.[2] The value of the sum of these losses would be equivalent to the net benefits of a control program if the probability of a trade ban were one for each year without a program and zero with the program.

[1] In July 1977 the U.S. government imposed additional border testing regulations on Canadian cattle imports in response to an increase in the prevalence of the disease in this country. For epidemiological reasons, all cattle destined for immediate slaughter and calves under six months of age were exempt from these regulations. It is therefore likely that any trade ban would only apply to feeder and breeding cattle.

[2] This section is summarized from Fred O'Riordan, "A Partial Equilibrium Analysis of Potential Welfare Losses in Trade Due to Brucellosis in Canadian Cattle," unpublished Working Paper, September 1978. It concentrates on the allocative effects of a trade restriction only. A restriction would have a large non-allocative impact as well (e.g., on the distribution of income across producers, on the balance of payments, etc.). These effectss are not analyzed here.

In the next section the functional form of the relationship between the subjective probability of a trade ban and the domestic prevalence of brucellosis is specified for beef cattle and dairy cattle with all other relevant variables assumed to be constant. This relationship and estimates of the annual prevalence of the disease for each program alternative yield the annual subjective probability of a ban under each alternative (including the no program alternative).

The results of the following two sections are used to calculate the expected value of net benefits for each program. These are presented, with a summary of the analysis, in the last section.

DETERMINING POTENTIAL WELFARE LOSSES

Partial equilibrium analyses of the welfare effects of tariff and non-tariff barriers to trade have commonly been conducted using a spatial price equilibrium model which explicitly allows for changes in the terms of trade for the commodity in question. The approach used here takes the terms of trade as fixed and concentrates on the demand and supply relationships of the domestic country in isolation. This approach has the advantage of requiring much less information on the international market than is required in a spatial equilibrium model and is more readily solved for changes in domestic welfare.[3]

Net social losses are calculated using Marshallian welfare analysis under conventional associated assumptions. It is assumed that the area under a Marshallian (fixed-income) demand curve is a measure of total utility or welfare derived from the consumption of a good, that the income effect associated with changes in the price of the good is zero, and that the marginal utility of income is the same for all consumers (or alternatively that consumers have identical homothetic preferences). The area under a supply curve is assumed to measure the social

[3] Ideally, welfare changes could be computed directly from an econometric model designed to forecast feeder and breeding cattle demand, supply, and export trade. Unfortunately, existing models for beef are expressed in terms of dressed weights and are designed to predict slaughter cattle prices and quantities. Similarly, dairy models are designed to forecast the demand for and supply of dairy products. These models are thus inappropriate for the requirements of this analysis.

opportunity cost of resources used to produce a good. It is also assumed that the prices of all other goods in the economy accurately reflect the social opportunity cost of resources used in their manufacture.

Given these assumptions, social welfare changes resulting from a trade sanction are estimated for the base year (1977) and estimated and discounted for subsequent years by calculating changes in consumers' and producers' surpluses. Consumers' surplus is the excess of what consumers would be willing to pay for a good over the amount they actually pay. It is measured by the area below the demand curve for the product at a given quantity and above the equilibrium price line. Producers' surplus is the excess of what producers actually receive from the sale of a good over the minimum amount required to induce them to produce it. This is measured by the area above the supply curve for the product at a given quantity and below the equilibrium price line. Net social losses are given by decreases in the sum of these two economic surpluses under the assumption that society is indifferent to any income redistribution that might result.

The market for Canadian beef (or dairy) cattle for a given year is represented in Figure 1, where SS^1 is the supply curve, DD^1 the domestic demand curve, and P_oD_f the foreign demand curve. The latter curve is horizontal, indicating that foreign demand is perfectly elastic at the world price, P_o. The supply curve is drawn through the origin and the domestic demand curve is drawn to intersect each axis for convenience of exposition only. In pratice, the foreign demand curve would be less elastic than illustrated if the world price were influenced by changes in Canadian cattle exports.

A total demand curve can be derived from the diagram by the horizontal summation of domestic and foreign demand as DAD_f. The total curve coincides with the domestic demand curve for quantities up to OQ_o (point A), and with the foreign demand curve for quantities greater than OQ_o. Figure 1 reflects the fact that Canada is a net exporter of live beef (or dairy) cattle for feeding and breeding purposes, i.e., the import parity or world price, P_o, exceeds the domestic equilibrium price, P_2. In the absence of any trade restriction, Canada would produce OQ_1 of live cattle at price OP_o, of which OQ_o would be sold domestically and $OQ_1 - OQ_o$ exported.

The welfare effects of a trade restriction can be deduced directly from the diagram. Assuming that there was to be a total trade restriction, the quantity $OQ_1 - OQ_o$, previously exported, would in the very short run[4] be diverted into the domestic market. This would lead to a direct loss of export revenue equal to area ABQ_1Q_o. However, on the domestic market most of these cattle would be sold as normal, healthy animals and yield an indirect social gain equal to area ACQ_1Q_o.[5] Subtracting this indirect gain from the loss in export revenues leaves a net social loss equal to triangle ABC, or $^1/_2(P_o - P_1)(Q_1 - Q_o)$, in the very short run.[6] It is assumed for the purposes of this study that the very short run would be two years (1977 and 1978) for beef or dairy cattle production. This reflects the fact that in livestock production a considerable lag exists between the time when an investment decision is made and the time when an animal is ready for sale, and that during the interval, when most of his costs are sunk, the producer has little ability or incentive to change his output.[7]

Given the assumption that for the remaining period of analysis most inputs to the producer would be variable and supply would be price-responsive, the welfare effects which would occur during the remaining 18 years may be derived from Figure 2. In the very short run, the

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[4]Very short run is a period during which all factors of production are fixed and output is not variable. This distinguishes it from short run, during which at least one input is fixed but output is variable, facilitating limited structural adjustment.

[5]It is assumed that the actual number of infected animals is sufficiently small to be ignored for this analysis. It is also assumed throughout that the social value of each marginal dollar of foreign exchange is equal to that of a marginal dollar generated from domestic sales, i.e., changes in the value of cattle exports are insufficient to affect the value of the Canadian dollar in foreign currency markets.

[6]This is the simplest way of expressing the welfare loss in the very short run. Alternatively, Figure 1 shows that the total value of production or willingness to pay was $DABQ_1O$ before the trade ban, and only DCQ_1O after – a net loss of ABC. Finally, the welfare loss can be expressed in terms of changes in consumers' and producers' surpluses. This requires the substitution in Figure 1 of the supply curve illustrated (which is short-run) by the very-short-run notional supply curve, BQ_1, which is perfectly inelastic, indicating that output is not variable. The change in consumers' surplus is from DAP to DCP_1, or $+P_oACP_1$. The change in producers' surplus is from P_oBQ_1O to P_1CQ_1O, or $-P_oBCP_1$. The net change in surplus is therefore equal to $-$ABC in the very short run.

[7]However, his rate of throughput at any particular time can be adjusted through changes in the number of animals retained for breeding, the rate of herd culling, and the number of calves slaughtered for veal. In other words, although his output during the total period would be constrained, he would have some control over what form the output would take and the rate at which it would be released on the market.

cattle barred from export markets would be diverted to the domestic market as previously explained. This would result in a movement from point B to point C and a corresponding decrease in price from OP_o to OP_1. While point B was an equilibrium position for cattle production, the market would be in disequilibrium at point C. Price OP_1 would be a market clearing price in the very short run, but an excess demand of $OQ_1 - OQ_3$ would develop as the cattle diverted from export markets were sold. The price would be driven up from OP_1 to the domestic equilibrium level of OP_2 and production would stabilize at OQ_2.

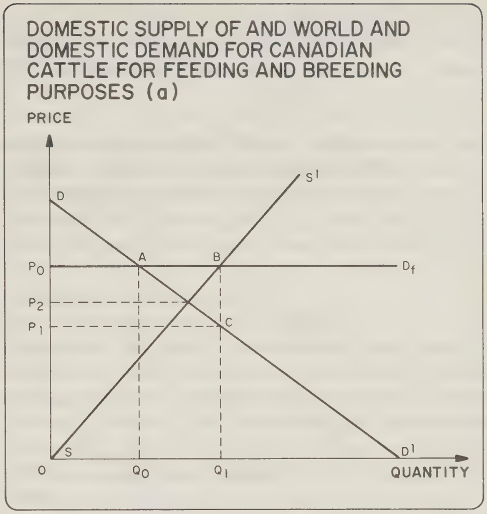

Figure 1

One may derive short-run welfare changes by comparing this new equilibrium position with the one that would have existed if there was no loss in trade. Consumers' surplus if there was no restriction would de DAP_o. If there was a restriction it would be DEP_2, yielding a net gain of P_oAEP_2. Producers' surplus would decline from P_oBS to P_2ES – a net loss of P_oBEP_2. Combining these changes in surplus yields a net social loss equivalent to area ABE or $^1/_2(P_o-P_2)(Q_1-Q_o)$. This loss is smaller than the loss occurring in the very short run by area BEC. Triangle BEC represents the net gain in moving from disequilibrium point C to equilibrium point E, thereby reducing output from OQ_1 to OQ_2. It is the difference between the real resource cost that this extra output would entail if actually produced (area EBQ_1Q_2) and its domestic value (area ECQ_1Q_2). Moving from point C to point E removes this source of social cost due to oversupply in the domestic market. For each marginal increment of output in excess of OQ_2 there is a net social loss equivalent to the vertical difference between the supply (marginal cost) curve and the domestic demand (marginal utility) curve.

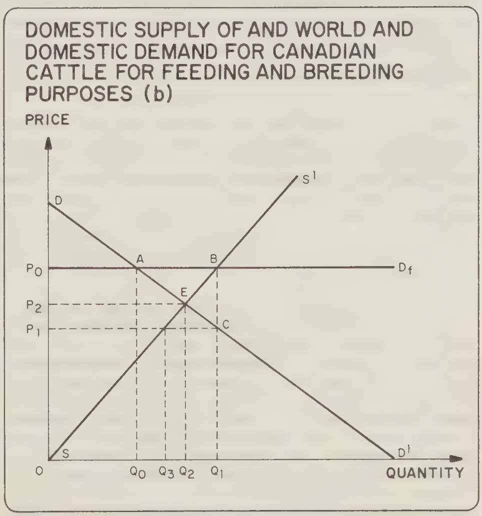

Figure 2

To estimate the annual net social losses using the methodology outlined, it is first necessary to derive demand and supply curves for beef cattle and then for dairy cattle for 1977. Demand and supply functions corresponding to DD^1 and SS^1 in Figure 1, which are assumed to be linear within the region relevant to this analysis, have the following form:

Demand: $Q = a - bP$

Supply: $Q = c + dP$

where Q is the quantity traded on the domestic market and P is the average producer price on the domestic market. The slopes, b and d, of these functions are determined using weighted price and quantity data and

estimated demand and supply elasticities.[8] The intercepts, a and c, are then easily calculated. Foreign demand is assumed to be perfectly elastic at the observed average world price.

For subsequent years, parallel curves are estimated based on these 1977 equation estimates for foreign demand, domestic demand, and supply. This is accomplished for each year by multiplying the intercepts of the previous year's demand and supply equations by annual growth factors.[9]

Table 1 in the appendix shows annual net social losses for beef, dairy, and the total of beef plus dairy. These annual losses are then discounted in Table 2 using a real social discount rate of 10 percent a year. The total net present value of these losses is $42.7 million. This value is the maximum loss which could occur under the assumption that the prevalence of the disease would be sufficient to cause a total ban on exports for each of the 20 years studied. Since this is the maximum potential social loss from a trade ban, it is also the maximum potential benefit that could be attributed to any control program under the same assumption. Before the actual net benefits of each program can be estimated, it is necessary to determine the probability of a trade sanction occurring under each program compared with the probability if there was no program. This is the subject of the next section.

DETERMINATION OF SUBJECTIVE PROBABILITIES

Using classical probability theory, the probability of an event occurring can be determined from its relative frequency distribution. However, when dealing with unique historical events which cannot be replicated, it is impossible to generate frequencies and in this way determine probabilities. In situations such as these it is only possible to give a personal or subjective probability of the event's occurrence, given the best prior knowledge available.[10]

Figures 3 and 4 show the subjective probability of a trade ban for beef and dairy cattle as a continuous exponential function of the domestic prevalence of brucellosis. These probabilities are based on professional opinion and on the sample threat of a trade sanction by the U.S. government in June 1977.[11] The shape of these functions is such that the upper and lower probability limits are asymptotes of the functions, and the probability of a ban rises relatively quickly between critical prevalence levels of the disease. These levels are approximately 0.2 and 1.2 percent for beef cattle and 0.6 and 2 percent for dairy cattle.

A triple binomial model, which is used elsewhere in the benefit-cost analysis to simulate the spread of the

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[8] The formula for b is derived as follows:

$$b = \frac{Q \times \eta}{P}, \text{ where } \eta = \text{domestic elasticity of demand}$$

$$\text{since } \eta = \frac{P}{Q} \cdot \frac{\Delta Q}{\Delta P} \text{ and } b = \frac{\Delta Q}{\Delta P}.$$

The formula for d may be similarly derived:

$$d = \frac{Q \times \epsilon}{P}, \text{ where } \epsilon = \text{elasticity of supply.}$$

Based on available studies, it is assumed that the elasticities of demand and supply are −0.7 and 0.15 for beef and −0.7 and 0.25 for dairy. Sensitivity analysis indicated that the welfare losses were strongly influenced by the elasticity values used This is discussed in more depth in O'Riordan, *op.cit.*

[9] Given available information, it is assumed that the long-term annual domestic demand for and supply of beef cattle will increase 3.5 and 3 percent, and 0.5 and −1.0 percent for dairy cattle, and that the foreign demand for (export price of) beef and dairy cattle will rise 4.0 and 2.0 percent. This implies that the price of cattle will rise in real terms during the period of analysis. It is implicitly assumed here, as elsewhere, that all other relevant parameters such as the current prevalence level of brucellosis remain constant.

Shifting the curves in a parallel manner forces the elasticities of demand and supply at each new annual equilibrium level of output to increase slightly since the slope of each curve is held constant. The elasticities could have been held constant at their initial levels through the more tedious procedure of shifting the means while holding the elasticities constant and adjusting the intercepts and the slopes for each year. Alternatively, constant elasticity demand and supply curves could have been used which are linear in logarithms rather than natural numbers. However, the preceding approach was used because of its simplicity and, on the basis of available evidence, there is no more reason to expect that actual elasticities will remain constant than increase slightly over time.

[10] There are more comprehensive ways of dealing with uncertainty than the approach taken here. Such methods are generally called risk analyses. Risk analysis eliminates the need for restricting one's judgement concerning the probability of an uncertain event to a single judgement of the future. Instead of being restricted to a single value for a decision variable, judgements may take the form of a subjective probability distribution. The most popular way of conducting risk analysis is the Monte Carlo simulation technique. Another method is Bayesian decision analysis which utilizes both subjective and sample (or objective) evidence. A more formal approach to dealing with uncertainty is not used here because of the lack of prior information.

[11] These opinions include, among others, those of the author and of Dr. John Kellar, Chief, Brucellosis Planning, Food Production and Inspection Branch, Agriculture Canada.

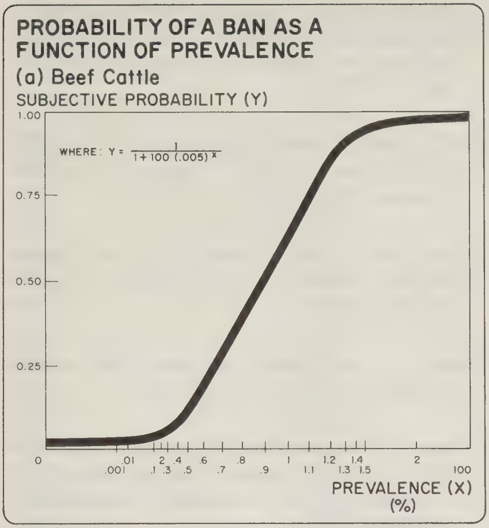

Figure 3

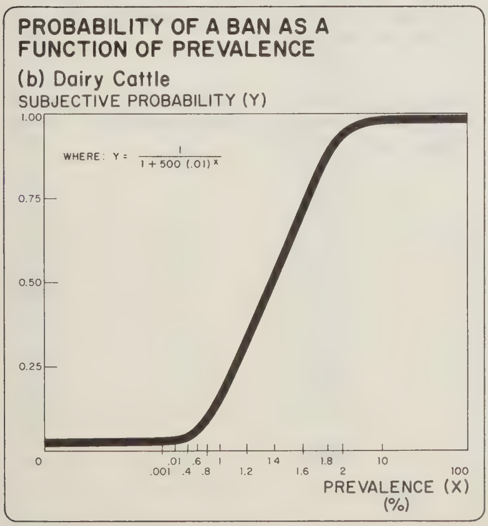

Figure 4

disease, is used here to estimate prevalence levels by program for each of the 20 years studied. (See Tables 3 and 4 of the appendix.)

The results of this and the previous section are used to calculate the expected value of benefits for each program alternative. The final section presents these benefits and a brief summary of the analysis.

SUMMARY AND RESULTS

The benefits of a program to control brucellosis are defined as the avoidance of the social costs that would otherwise occur in the absence of the program. The expected value of benefits from averting a trade restriction is a function of the welfare losses which would result from the restriction, the probability of the restriction taking place if there was no program, and the (presumably smaller) probability under a given program. More precisely the expected value is equal to the value of averted losses times the difference between the probability of the losses occurring in the absence and the presence of the program.[12]

Table 4 shows the expected value of annual benefits for each program alternative for beef and dairy cattle. The values are summarized in Table 5. The size of these expected benefits relative to the maximum potential benefits indicates that all programs would likely be effective in reducing the risk of trade sanctions being imposed against Canadian cattle imports. The most effective program is the herd depopulation approach and the least effective is the test and slaughter alternative, although the difference is not large. Expected benefits from the former alternative are $41.241 million, compared with $40.065 from the latter. The present program is almost as effective as the herd depopulation program with its expected benefits of $41.069 million.

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[12] This is represented by the following equation:

$$E(NSB) = \sum_{t=0}^{19} (NSL)_t \, (Pr^1 - Pr_i^2)_t \, ,$$

where NSL_t = present discounted value of social losses from a total ban in year t,

Pr^1 = subjective probability of a total ban in year t in the absence of a program, and

Pr_i^2 = subjective probability of a total ban in year t under the i^{th} program.

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APPENDIX

TABLE 1. MAXIMUM ANNUAL NET SOCIAL LOSSES

Year	Net Social Loss Beef (1)	Dairy (2)	Total (1+2)
		$	
1977	243,955	506,267	750,222
1978	259,566	677,005	936,571
1979	228,407	661,368	889,775
1980	246,174	874,360	1,120,534
1981	267,022	1,148,689	1,415,711
1982	291,456	1,493,372	1,784,828
1983	320,070	1,922,691	2,242,761
1984	353,559	2,451,516	2,805,075
1985	392,744	3,096,328	3,489,072
1986	438,584	3,875,304	4,313,888
1987	492,205	4,808,401	5,300,606
1988	554,926	5,917,444	6,472,370
1989	628,288	7,226,223	7,854,511
1990	714,091	8,760,587	9,474,678
1991	814,436	10,548,548	11,362,984
1992	931,770	12,620,396	13,552,166
1993	1,068,940	15,008,782	16,077,722
1994	1,229,254	17,748,869	18,978,123
1995	1,416,553	20,878,514	22,295,067
1996	1,635,284	24,438,197	26,073,481

TABLE 2. PRESENT VALUE OF MAXIMUM ANNUAL NET SOCIAL LOSSES

Year	Present Value of Net Social Loss Beef (1)	Dairy (2)	Total (1) + (2)
		$	
1977	243,955	506,267	750,222
1978	235,969	615,459	851,428
1979	188,766	546,585	735,351
1980	184,954	656,920	841,874
1981	182,380	784,457	966,837
1982	180,971	927,267	1,108,238
1983	180,671	1,085,309	1,265,980
1984	181,432	1,258,015	1,439,447
1985	183,218	1,444,460	1,627,678
1986	186,003	1,643,508	1,829,511
1987	189,767	1,853,848	2,043,615
1988	194,498	2,074,029	2,268,527
1989	200,192	2,302,498	2,502,690
1990	206,847	2,537,630	2,744,477
1991	214,466	2,777,763	2,992,229
1992	223,058	3,021,223	3,244,281
1993	232,633	3,266,349	3,498,982
1994	243,201	3,511,519	3,754,720
1995	254,780	3,755,184	4,009,964
1996	267,382	3,995,841	4,263,223
Total[1]	4,175,143	38,564,131	42,739,274

[1] The Total is calculated as follows: $PV\ (NSL) = \sum_{t=o}^{19} NSL_t\ (1+r)^{-t} = NSL_0 + \frac{NSL_1}{(1+r)} + \frac{NSL_2}{(1+r)^2} + \ldots + \frac{NSL_{19}}{(1+r)^{19}}$, where $r = .10$ and $t_o = 1977$.

TABLE 3. PREVALENCE AND SUBJECTIVE PROBABILITY ASSUMING NO PROGRAM

Year	Beef		Dairy	
	Prevalence (X)	Probability (Y)	Prevalence (X)	Probability (Y)
1977	.23	.0327	1.15	.2852
1978	.34	.0571	1.48	.6459
1979	.61	.2021	1.59	.7517
1980	1.10	.7725	1.72	.8464
1981	2.02	.9977	1.94	.9382
1982	3.61	.9999	2.34	.9897
1983	6.14	.9999	2.98	.9995
1984	9.79	.9999	3.86	.9999
1985	14.41	.9999	4.79	.9999
1986	19.40	.9999	5.52	.9999
1987	23.94	.9999	5.98	.9999
1988	27.45	.9999	6.24	.9999
1989	29.84	.9999	6.40	.9999
1990	31.33	.9999	6.53	.9999
1991	32.24	.9999	6.62	.9999
1992	32.82	.9999	6.71	.9999
1993	33.21	.9999	6.79	.9999
1994	33.50	.9999	6.87	.9999
1995	33.72	.9999	6.94	.9999
1996	33.90	.9999	7.01	.9999

TABLE 4. PREVALENCE, SUBJECTIVE PROBABILITY, AND PRESENT VALUE OF EXPECTED BENEFITS
PART 1. TEST AND SLAUGHTER ALTERNATIVE

Year	Beef			Dairy		
	Prevalence (X)	Probability (Y)	Expected Benefits	Prevalence (X)	Probability (Y)	Expected Benefits
			– $ –			– $ –
1977	.08	.015	4,318	.41	.013	137,806
1978	.10	.017	9,462	.58	.028	380,231
1979	.09	.016	35,129	.61	.032	393,323
1980	.08	.015	140,103	.58	.028	537,558
1981	.07	.014	179,407	.50	.020	720,602
1982	.08	.015	178,238	.44	.015	903,900
1983	.08	.015	177,943	.40	.013	1,071,200
1984	.09	.016	178,511	.36	.010	1,244,806
1985	.09	.016	180,268	.34	.009	1,430,593
1986	.10	.017	182,822	.34	.010	1,627,730
1987	.11	.018	186,332	.34	.010	1,836,051
1988	.12	.019	190,783	.36	.010	2,052,252
1989	.14	.021	195,968	.40	.013	2,273,487
1990	.15	.022	202,276	.43	.014	2,501,088
1991	.17	.024	209,297	.49	.019	2,725,541
1992	.18	.025	217,459	.54	.024	2,949,922
1993	.20	.028	226,096	.61	.032	3,161,173
1994	.22	.031	235,637	.68	.044	3,357,363
1995	.25	.036	245,582	.74	.057	3,540,763
1996	.28	.042	256,125	.81	.077	3,687,762
Total			3,431,756			36,533,151

TABLE 4. PREVALENCE, SUBJECTIVE PROBABILITY, AND PRESENT VALUE OF EXPECTED BENEFITS
PART 2. TEST AND SLAUGHTER WITH ADULT VACCINATION ALTERNATIVE

Year	Beef			Dairy		
	Prevalence (X)	Probability (Y)	Expected Benefits	Prevalence (X)	Probability (Y)	Expected Benefits
			– $ –			– $ –
1977	.09	.016	4,074	.35	.0099	139,375
1978	.09	.016	9,698	.35	.0099	391,432
1979	.06	.014	35,507	.20	.0050	408,135
1980	.05	.013	140,473	.10	.0032	553,915
1981	.04	.012	179,772	.08	.0029	733,703
1982	.04	.012	178,781	.07	.0028	915,120
1983	.04	.012	178,485	.05	.0025	1,082,053
1984	.04	.012	179,237	.05	.0025	1,254,744
1985	.03	.012	181,001	.04	.0024	1,440,849
1986	.03	.012	183,752	.03	.0023	1,639,564
1987	.03	.012	187,471	.03	.0023	1,849,399
1988	.04	.012	192,145	.03	.0023	2,069,051
1989	.04	.012	197,770	.03	.0023	2,296,972
1990	.04	.012	204,344	.02	.0022	2,531,793
1991	.05	.013	211,656	.02	.0022	2,771,374
1992	.05	.013	220,136	.02	.0022	3,014,274
1993	.05	.013	229,586	.02	.0022	3,258,836
1994	.05	.013	240,015	.02	.0022	3,503,443
1995	.06	.014	251,188	.02	.0022	3,746,547
1996	.06	.014	263,612	.02	.0022	3,986,651
Total			3,468,703			37,587,230

TABLE 4. PREVALENCE, SUBJECTIVE PROBABILITY, AND PRESENT VALUE OF EXPECTED BENEFITS
PART 3. PRESENT PROGRAM ALTERNATIVE

Year	Beef			Dairy		
	Prevalence (X)	Probability (Y)	Expected Benefits	Prevalence (X)	Probability (Y)	Expected Benefits
			– $ –			– $ –
1977	.080	.015	4,318	.41	.0130	137,806
1978	.050	.013	10,406	.38	.0114	390,509
1979	.030	.012	35,884	.27	.0069	407,097
1980	.020	.011	140,842	.17	.0044	553,127
1981	.010	.010	180,136	.09	.0030	733,624
1982	.010	.010	179,143	.06	.0026	915,305
1983	.010	.010	178,846	.03	.0023	1,082,270
1984	.010	.010	179,600	.02	.0022	1,255,122
1985	.005	.010	181,367	.02	.0022	1,441,138
1986	.004	.010	184,124	.01	.0021	1,639,892
1987	.004	.010	187,850	.01	.0021	1,849,770
1988	.004	.010	192,534	.01	.0021	2,069,466
1989	.003	.010	198,170	0	.0020	2,297,663
1990	.003	.010	204,758	0	.0020	2,532,301
1991	.002	.010	212,300	0	.0020	2,771,930
1992	.002	.010	220,805	0	.0020	3,014,878
1993	.002	.010	230,283	0	.0020	3,259,490
1994	.002	.010	240,745	0	.0020	3,504,145
1995	.002	.010	252,207	0	.0020	3,747,298
1996	.002	.010	264,681	0	.0020	3,987,450
Total			3,478,999			37,590,281

TABLE 4. PREVALENCE, SUBJECTIVE PROBABILITY, AND PRESENT VALUE OF EXPECTED BENEFITS
PART 4. HERD DEPOPULATION ALTERNATIVE

Year	Beef			Dairy		
	Prevalence (X)	Probability (Y)	Expected Benefits	Prevalence (X)	Probability (Y)	Expected Benefits
			– $ –			– $ –
1977	.080	.015	4,318	.4100	.0130	137,806
1978	.010	.010	11,114	.0800	.0029	547,468
1979	.004	.010	36,262	.0200	.0022	409,665
1980	.002	.010	141,027	.0100	.0021	561,207
1981	.001	.010	180,136	.0030	.0020	734,409
1982	0	.010	179,143	.0020	.0020	915,862
1983	0	.010	178,846	.0010	.0020	1,082,596
1984	0	.010	179,600	.0010	.0020	1,255,373
1985	0	.010	181,367	.0010	.0020	1,441,427
1986	0	.010	184,124	.0010	.0020	1,640,057
1987	0	.010	187,850	.0010	.0020	1,849,955
1988	0	.010	192,534	.0005	.0020	2,069,674
1989	0	.010	198,170	0	.0020	2,297,663
1990	0	.010	204,758	0	.0020	2,532,301
1991	0	.010	212,300	0	.0020	2,771,930
1992	0	.010	220,805	0	.0020	3,014,878
1993	0	.010	230,283	0	.0020	3,259,490
1994	0	.010	240,745	0	.0020	3,504,145
1995	0	.010	252,207	0	.0020	3,747,298
1996	0	.010	264,681	0	.0020	3,987,450
Total			3,480,270			37,760,654

TABLE 5. PRESENT VALUE OF EXPECTED BENEFITS BY PROGRAM

Group	Test and Slaughter	Test and Slaughter with Adult Vaccination	Present Program	Herd Depopulation
		$		
Beef	3,431,756	3,468,703	3,478,999	3,480,270
Dairy	36,533,151	37,587,230	37,590,281	37,760,654
Total	40,064,907	41,055,933	41,069,280	41,240,924

ECONOMIC INDICATORS

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978 I	1978 II	1978 III	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual
Production and Income											
1. GNP at Market Prices[a]	$ mil.	221,428[b]	228,052[b]	233,600[b]	238,548[b]	230,407[b]	249,308[b]	255,964[b]	265,080[b]	271,780[b]	260,533
2. Farm Cash Receipts Total[d]	$ mil.	2,929.9[b]	2,727.0[b]	2,900.3[b]	3,341.6[b]	11,899.0[b]	3,365.3[b]	3,237.9[b]	3,436.2[b]	3,908.1[b]	13,947.5
3. – Total Crops[d]	$ mil.	1,470.7[b]	1,026.4[b]	1,161.0[b]	1,248.0[b]	4,906.1[b]	1,458.3[b]	1,186.1[b]	1,468.5[b]	1,790.4[b]	5,903.3
4. – Total Livestock[d]	$ mil.	1,360.5[b]	1,612.0[b]	1,645.3[b]	1,923.7[b]	6,541.5[b]	1,830.9[b]	1,930.3[b]	1,866.2[b]	2,026.9[b]	7,654.3
5. Net Income Rec'd by Farm Operators[a]	$ mil.	3,020.0[b]	4,152.0[b]	3,252.0[b]	3,632.0[b]	3,541.0[b]	4,080.0[b]	4,584.6[b]	4,016.0[b]	4,224.0[b]	4,226.0
Trade											
6. Agricultural Exports	$ mil.	946.4	1,230.5	1,261.3[b]	1,391.8[b]	4,846.3	1,204.4	1,354.7	1,663.9	1,884.8	6,107.8
7. Agricultural Imports	$ mil.	876.7[b]	1,088.5	943.2	1,104.4	4,015.06	1,129.2	1,181.6	1,129.4	1,240.4	4,680.6
8. Real Domestic Product, Ag[a]	1971=100	119.5[b]	114.3[b]	117.5[b]	119.7[b]	117.8[b]	118.0[b]	118.3[b]	115.8[b]	113.0[b]	116.4
9. Real Dom. Prod., Less Ag[a]	1971=100	133.6	135.1[b]	136.6[b]	138.3[b]	135.9[b]	139.4[b]	139.3[b]	141.3[b]	141.2[b]	140.3
Price Indexes											
10. Farm Input Price Index	1971=100	190.8	200.2	203.2	209.2	200.9	224.0	228.9[b]	230.5[b]	234.1	229.4
11. – Buildings and Fencing	1971=100	193.5	197.6	203.1	209.9	201.0	216.1	223.2	229.5	235.3	226.0
12. – Machinery & Motor Veh.	1971=100	172.6	174.0	176.0	182.1	176.2[b]	188.0	191.8[b]	196.2[b]	205.3	195.3
13. – Crop Production	1971=100	217.9	225.5	228.3	230.2	225.5	238.6	252.5[b]	258.5[b]	266.5	254.0
14. – Animal Production	1971=100	178.0	203.7	207.3	218.2	201.8	246.8	252.3[b]	249.2[b]	247.8	249.0
15. – Hired Farm Labor	1971=100	214.5	217.9	223.9	225.4	220.4	228.0	232.8	235.7	237.8	233.6
16. – Interest	1971=100	284.5	284.5	284.5	284.5	284.5	310.6	310.6	310.6	310.6	310.6
17. Farm Prices of Ag. Prod.[d]	1971=100	192.7	206.8	209.9	221.9	217.6[b]	250.3[b]	250.7	247.7	246.4	248.8
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	153.9	372.9	418.8	342.4	1,288.0	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	458.0	462.3	479.3	490.3	473.0	499.7[b]	497.7[b]	466.7[b]	475.3	484.9
20. Av. Farm Labor Rates	$/hr.	3.67	3.73	3.78	3.84	3.76	3.89	3.95	4.01	4.08	3.98
21. Av. Hourly Earnings-Manuf.	$/hr.	6.67	6.77	6.87	7.03	6.83[b]	7.19[b]	7.37[b]	7.50	7.68	7.44
22. F.C.C.-Gross Loan Disburs.	$ mil.	78.4	127.8	205.7	121.7	533.6	35.4	174.7	192.4	145.2	547.7
23. CPI – All Items	1971=100	169.2	173.3	177.7	180.5	175.2	184.6	189.4	193.1	197.6	191.2
24. – Food at Home	1971=100	194.8	208.3	218.7	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0
25. – Food Away from Home	1971=100	192.6	194.9	202.2	207.3	199.3	213.1	220.8	227.3	232.4	223.4
26. Industry Selling Price Index – Food & Beverage	1971=100	195.1[b]	204.6[b]	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.3[b]	237.5	231.7

continued

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (concluded)

Item	Units or Base	1978					1979				
		I	II	III	IV	Annual	I	II	III	IV	Annual
Other Indicators											
27. Unemployment Rate	%	8.4	8.5[b]	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1	7.3	7.5
28. Exchange Rate	$ U.S.	1.11	1.13	1.14	1.18	1.14	1.19	1.16[b]	1.17	1.19	1.20
29. Av. Rate on New Demand Loans	%	8.70[b]	9.66[b]	10.03[b]	12.32	10.18	12.31	12.55	12.81	15.27	13.24
30. Quarterly Pop. Est.	mil.	23.39[b]	23.44[b]	23.50	23.55	23.48	23.60	23.65	23.69	23.74	23.67

[a] Seasonally adjusted at annual rates.
[b] Revised.
[c] Preliminary.
[d] Excludes Newfoundland.
[e] Excluding repair parts.
[f] N.A. = Not available.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Policy and Economics Branch, Marketing and Trade Division; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the Bank of Canada Review.

NOTES

AGRICULTURE CANADA REORGANIZED

Agriculture Canada's last major reorganization, to be phased in this spring and summer, emphasizes development – both market development and regional development.

The main feature of the reorganization is the formation of a new Regional Development and International Affairs Branch (RDIA) by the amalgamation of Intergovernmental and International Services Branch, part of the Production Development Directorate (farm development, animal and crop production) of Food Production and Inspection Branch, and the Agricultural Development Directorate of the old Policy, Planning and Economics Branch.

The Planning and Evaluation Directorate of the Policy, Planning and Economics Branch will henceforth report directly to the deputy minister as the Strategic Planning and Evaluation Branch (SPEB).

Branches amalgamated

The Market Analysis and Trade Policy Directorate of the Policy, Planning and Economics Branch will be amalgamated with Food and Agriculture Marketing Branch to form the Marketing and Economics Branch (MEB).

The new RDIA branch will have directors of regional development in each province. They will take over the responsibilities of the chief liaison officers and will have additional responsibilities for development, including marketing development. (RDIA will also be responsible for Canadian Farm Economics.)

A fourth regional director general will be appointed in Research Branch, with responsibility for the Atlantic Region.

Units detached

Some units of the Production Development Directorate of Food Production and Inspection Branch (FP and I) will be detached from the parent organization. The various components of the directorate will be allocated as follows:

to remain with Food Production and Inspection – Plant Products and Quarantine Division, Race Track Supervision, Record of Performance Operations of Animal Production;

to be administered with the Agricultural Stabilization Board (ASB) by the Senior Assistant Deputy Minister (Policy Advisor) who is also chairman of the Agricultural Stabilization Board and the Agricultural Products Board – Western Grain Stabilization unit and Crop Insurance Division of the old Production Development Directorate;

to go to RDIA – the director general's office, Farm Development and the remainder of Animal and Crop Production Divisions.

Regional directors

The appointment of regional development directors in each province will provide a more efficient and effective thrust to Agriculture Canada's economic development efforts. They will work closely with the provinces in responding to development needs and will be supported by strong regionally-based teams of development experts as well as by economic analysts at headquarters.

Market development

The new Marketing and Economics Branch will concentrate on identifying and developing markets for Canadian producers and processors.

PUBLICATIONS

Marketing of Agricultural Products. Richard L. Kohls and Joseph N. Uhl. November 1979. 612 pages. *Available for U.S. $18.95 from Macmillan Publishing Co. Inc., 866 Third Ave., New York 10022, or from your local bookseller.*

This review was prepared for CFE by Saiyed M.H. Rizvi, Food Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada.

Market economists have written and published much in the field of agricultural marketing, and many authors have tried to explain the underlying principles and the nature of numerous organizations engaged in buying and selling farm products in the domestic and international markets. Few marketing specialists have attempted, however, to provide a balanced look at the entire food marketing process which entails all the four major segments – farming, processing, distributing, and retailing.

Marketing of Agricultural Products, written by Richard Kohls and Joseph Uhl, is one such work which covers, in addition to marketing of agricultural products at the farm level, updated information about the organization and function of the overall food marketing system in the United States. This is the fifth edition of a book first published in 1955. Earlier editions were written exclusively by Richard Kohls.

Those who would suggest this book as a text for senior marketing classes will be doing great justice to the students.

On the whole, this volume provides readers with valuable insights into the entire food marketing process and an understanding of the organization, conduct, and performance of this important sector of the U.S. economy. It provides a basis for study and analyses of other marketing systems with similar characteristics. The book gives effective guidelines for using tools like normative and positive analyses for assessing competition and marketing performance – areas of immense importance to market economists in both the United States and Canada.

The authors have addressed themselves not only to the analysis of the basic attributes and problems of agricultural marketing, but also, in a broader context, to the functioning of the entire agro-food marketing and distribution system. Kohls and Uhl have used a blend approach for analysis – partly by functions, partly by institutions, partly by market levels, and partly by commodities. This approach enables the authors to present unique and complementary perspectives of the food marketing system and its interrelated problems.

To maintain a comprehensive continuity, the book is divided into six parts. In each part the authors attempt to integrate the descriptive, analytical, and normative approaches to analyze successfully the characteristics of the food marketing system and its problems.

Part I, The Framework of the Marketing Problem, has three chapters. In the first chapter, Introduction to Food Marketing, the authors outline the conceptual framework and the dimensions of the agricultural marketing process. The descriptive sections are supported by flowcharts that enhance the technical aspects of this chapter. The charts show the importance of each marketing segment, indicate how the marketing process forms an important bridge between farmers and consumers, and illustrate how it is continually affected by social resources, technology, and the laws and norms of society. In the second chapter are lists of the tools necessary for studying and evaluating the food marketing system. In the third chapter the authors show how the organization and complexity of food marketing is directly influenced by the nature of agricultural production. Key farm products and their characteristics influencing the food marketing system include bulkiness, perishability, quality difference, output variations and geographic specialization of individual farm products. Kohls and Uhl recognize several major problems: the difficulty of adjusting to dynamic market situations, the cost-price squeeze, the imbalance of the countervailing power of farmers and non-farming firms, and the declining pricing efficiency in the agricultural sector. The importance of farmers' marketing plans in mitigating these problems is rightly emphasized by the authors in the final part of this chapter.

In Part II, Food Markets and Institutions, the authors have done an excellent job of tracing the food production and marketing process from the input supply markets to the final level of food consumption. They describe the role and behavior of consumers, the role and importance of food processors, wholesalers and retailers, and the role and significance of international trade. Chapter 4 is devoted exclusively to an examination of consumer preferences. The authors identify, and give a comprehensive account of, major factors affecting consumer behavior in the food market: socio-

psychological values, nutrition, food prices, consumer incomes, and availability of food substitutes. They examine processors' contributions to form utility and new product developments. They study the nature and significance of competitive adjustments food wholesalers and retailers have made during the years. The authors emphasize that retailers, more than any other sector of the industry, "orient the industry to consumer demand and to the marketing concept and their pricing and merchandizing decisions are directed toward either accommodating or influencing the consumer's purchasing behavior." They add that it is important to realize that retailers are not indifferent to form prices and agricultural output, and, through their merchandizing strategies, retailers often play an important role in assisting farmers to sell seasonal gluts at reasonable prices. Recently, however, it appears that farmers are increasingly adjusting to retailers' needs and strategies. Kohls and Uhl extend their analysis from the domestic scene to the international market and present relevant features of the U.S. agricultural export market.

Part III, Prices and Marketing Costs, comprises analyses of these factors. Chapter 8 is basic and outlines prices and price-making forces in the food industry. In a microeconomic context, the authors study the effects of changing relative prices on the decisions of farmers, food marketing firms, and consumers. In Chapter 9 the authors investigate the role, nature, and implications of competition in food markets. They identify four important types of competition and examine the relevance of perfect competition, oligopoly, monopolistic competition, and monopoly. In Chapter 10, Kohls and Uhl study the nature of farm prices and factors influencing their movements. The authors concentrate on three sources of farm price movements – the business cycle, agricultural production cycles, and seasonal production and pricing factors. In Chapter 11 they examine the behavior of farm prices and outline the nature of marketing margins. Despite the progress made in improving operational efficiency and lowering unit costs of food marketing, continuously rising marketing costs are contributing to increasing marketing margins. The chance of reduced marketing costs in the near future seems quite slim.

Realizing that the food industry is a dynamic one, Kohls and Uhl in Part IV, the longest section, examine functional and organizational issues in the food marketing system. They deal with integration, decentralization, market power, market development, and futures markets. In Chapter 12 they describe how the successive stages of food production and marketing are vertically coordinated. They also examine specialization, diversification, market decentralization, and direct buying. In Chapter 13 they outline the characteristics and the role of cooperatives in the food industry. In Chapter 14 they introduce the concept of market development in the food industry and describe consumer advertising, consumer education, product development, trade promotion, merchandizing, packaging, couponing games, and so on. Chapter 15 deals with the nature and balance of market power in the food industry. The authors give special treatment to the market power of farmers and how they can increase it. Chapter 16 deals with market information and Chapter 17 with standardization and grading. In Chapter 18 the authors outline the important role of transportation as a marketing function, discuss the unique transportation needs of the food industry (with special attention to the agricultural commodity trucking exemption from regulations in the United States), and suggest how to improve the operational efficiency of food transportation. Having discussed in Chapter 19 the nature and significance of storage and warehousing, Kohls and Uhl describe the fundamentals of the commodity futures markets. The authors demonstrate how these markets can be used by farmers and food marketing firms.

Part V, Government and Food Marketing, consists of two chapters dealing with government price, income and marketing programs and with food marketing regulations. The authors discuss key issues in the debate over the effects of farm policy on farm prices and incomes, agricultural output and stability, food marketing costs, retail food prices, and fundamentals of major laws and regulations influencing the food marketing system. The authors concentrate on competitive regulations, regulations to control monopolies, trade-facilitating and service regulations, consumer protection regulations, direct food regulations, and regulations to foster economic and social growth.

Kohls and Uhl assign Part VI to sub-sector analyses of several major food and non-food agricultural commodities such as livestock and meat products, milk and dairy products, poultry and eggs, grains, cotton, textile, and tobacco products. They examine one of the most complex marketing systems – livestock and meat marketing – as well as milk and dairy products marketing, poultry, egg and grain marketing, and cotton, textile and tobacco products marketing.

At the end, the book has an instructive glossary of technical terms used throughout the book and a subject index.

IN REPLY

The following is a reply from R.P. Zentner, B.H. Sonntag, J.B. Bole, and U.J. Pittman to Mr. S. Reimche's comments on their article "An Economic Assessment of Dryland Cropping Programs in the Prairie Provinces: Income Variability" in our December 1979 issue. Mr. Reimche's remarks appeared in the April 1980 edition of CFE.

Several inconsistencies in Mr. Reimche's comments need clarification.

Farmers make decisions regarding resource use, output levels, and product mix by evaluating the opportunities or alternatives available at some particular time. Such evaluations are made in relation to the resources and characteristics of individual farms. The production processes and economic environment in which the farmer operates are not known with certainty. Nevertheless, the farm manager formulates expectations about the possible outcomes based on his experience, knowledge, and other available information.

Two goals that most farmers have are to enchance a farm's profitability and viability. To achieve these goals, farm managers estimate expected net income, resource use, expected income variability, risk, etc., for each of the alternatives being considered.

A farm's production processes can be broken into two components. One is the set of inputs under the farm manager's control. This includes the amount of seed, fertilizer, labor, herbicides, land, etc. The second is the set of inputs that is beyond his control. This includes rainfall, hail, disease, and insects. The second component is largely responsible for output variability. Output or yield variability arises because the effects of these random components (and the interactions with some of the controllable inputs) cannot be known with certainty when decisions must be made. Farm managers can only predict the occurrence of these random components.

Yield is only one component of income. The other relates to input and product prices. Knowledge of input and product prices is needed to make the best allocation of inputs and to produce the optimal quantities and types of product. Input prices are generally known at the time production decisions are made and as a result probably constitute a small proportion of the total risk associated with a production plan. Product prices constitute a major source of income variability as they tend to fluctuate considerably from year to year, reflecting changes in world demand and supply.

It is necessary to be aware of the inverse relationship between the price and quantity of a product sold. To sell more of a product it is generally necessary to accept a lower price. In Canada the majority of cereal grain is marketed through the Canadian Wheat Board (CWB). One of the CWB's objectives is to secure the highest possible prices for grains. One way in which the CWB can achieve this objective is through delivery quotas. Quotas restrict supply, thereby enabling prices to be maintained above the levels that might prevail in their absence. The fact that the CWB has legal authority to implement quota policies does add an additional consideration to the evaluation of cropping programs. This factor was not explicity considered in this study. Such an analysis, however, could be a logical extension of the present study.

The measure of income used in this study was expected net income. As pointed out in the earlier study by the same authors, these values represent the return to owner equity and management.[1] They represent the funds remaining after paying for all cash costs, depreciation, and labor (i.e. the operator, his family, and hired labor). In the study, three prices (or opportunity costs) for labor were considered. The opportunity costs for labor represent the hourly wage that farm labor could earn in the next best alternative (possibly non-farm industry employment). These opportunity costs must be considered in evaluating the profitability of the alternative cropping programs because of the differential labor requirements. Presumably, if the opportunity cost of farm labor was greater in non-farm employment than could be earned on the farm, farm labor would have an incentive to accept employment elsewhere. A price for labor of $10 an hour used in the study reflects the opportunity cost for an individual who may be highly skilled (e.g., a welder, carpenter, or mechanic). A price for labor of $0 an hour reflects an individual who has no alternative employment opportunities outside the farm or prefers not to consider them. Consequently, the figures under this price scenario in both studies could be interpreted as the expected net return to owner equity, management, and labor. Such an

[1] R.P. Zentner, *et al.*, "An Economic Assessment of Dryland Cropping Programs in the Prairie Provinces: Expected Net Incomes and Resource Requirements," *Canadian Farm Economics* 14(4) (August 1979): 8-19.

interpretation does not make explicit the differentials in labor use among the cropping programs.

The study makes use of a computer model of dryland grain farms. The model contains mathematical representations of the important biological and economic processes common to most grain farms. The model has sufficient flexibility to enable good representation of individual farms that differ widely in size, resource endowments, management practices, financial considerations, etc. In this study a typical or average farm situation, one for each soil zone, was used. The objective was to provide some indication of the differentials in net income, resource use, and income variability that may be expected under the alternative cropping practices for several economic situations. As is clearly stated in the study, it was not intended that these figures be representative of all farm situations in each soil zone.

The model is now being used only as a research tool. It does have the potential to be a farm planning tool for farmers and extension personnel. Access is limited, however, because of the lack of an adequate delivery system (i.e. computer terminals, computer technicians, etc).

CORRECTION

In the last issue of Canadian Farm Economics the Deputy Minister's introduction stated *inter alia* that "As a result, the Economics Branch has now become the Marketing and Economics Branch."

This statement should have read, "As a result, the Economics Branch became the Policy, Planning and Economics Branch which in turn has now become a major component of two new branches – Regional Development and International Affairs, and Marketing and Economics."

IN REPLY TO AUTHORS AND EDITORS REGARDING JUNE 1980 *CANADIAN FARM ECONOMICS*

I have read one or more of the following articles:

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(2) Benefits from a Reduction in the Prevalence of Undulant Fever in Humans
(3) Benefits from a Reduction in the Risk of External Trade Sanctions

1. My comments are on article number (1) (2) (3).
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1 2 3 4 5 6 7 8 9 10

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CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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CANADIAN FARM ECONOMICS

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Agriculture Canada

HON. EUGENE WHELAN, MINISTER — GAÉTAN LUSSIER, DEPUTY MINISTER

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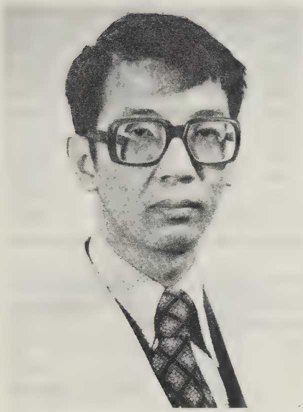
CANADA'S AGRICULTURAL AND FOOD TRADE IN THE 1970s



During the 1970s, Japan displaced the United States as the largest importer of Canadian agricultural products, and Britain's market share was almost cut in two. At the same time, Caribbean countries were importing fewer agricultural products from Canada, while East European, Middle East, and East Asian countries were importing more.

*Soe Lin and Gail Labrosse**

INTRODUCTION

This article reviews Canada's agricultural trade performance during the past decade. The following trends are evident in the major developments in Canada's agricultural trade during that time:

- the growth in agricultural exports and imports in absolute terms and a decline relative to exports and imports of all merchandise;
- changes in the market shares of major importers of Canada's agricultural products and major exporters of agricultural products to Canada;
- and the changing structure and commodity composition of Canadian agricultural trade.

The article updates and builds upon an earlier one by J.S. Lohoar.[1]

AGRICULTURAL TRADE PERFORMANCE

The value of agricultural exports increased from $1.7 billion in 1970 to $6.1 billion in 1979, a compounded growth rate of 15 percent (Table 1). During the same period the compounded growth rate of all exports of merchandise was 16 percent. Hence, the agricultural share of total exports declined slightly from 10.2 percent to 9.5 percent. The agricultural share of total exports increased from 1972 to 1974 as a direct result of the worldwide shortage in major agricultural commodities and the subsequent rapid rise in agricultural prices, particularly those of grain. But when grain prices declined from the unprecedented peaks of the 1972-74 period, the agricultural share of total exports decreased from 1975 until 1978.

The compounded growth rate (from 1970 to 1979) of agricultural imports was 15 percent and of total imports 18 percent. Consequently, the agricultural share of imports declined steadily from a peak of 9.3 percent in 1973 to 7.5 percent in 1979.

The agriculture trade balance remained positive during the decade, and its contribution to the total trade balance is substantial. Since 1972, with the exception of 1978, at least 50 percent of any positive total trade balance was attributable to the positive trade in agricultural products.

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*Soe Lin is an economist and Gail Labrosse a technical support officer with the International Trade Policy Division, Marketing and Economics Branch, Agriculture Canada, Ottawa.

[1] J.S. Lohoar, "Canada's Agricultural Trade – Recent Developments and Export Prospects," *Canadian Farm Economics* 13 (August 1978).

TABLE 1. CANADIAN TRADE, 1970-79[a]

Year	Agricultural Exports	All Exports	Agricultural Share of Exports	Agricultural Imports	All Imports	Agricultural Share of Imports	Agricultural[b] Trade Balance	Total Trade Balance
	— $ million	—	— % —	— $ million	—	— % —	— $ million	—
1970	1 684	16 458	10.2	1 283	13 952	9.2	401	2 506
1971	1 993	17 397	11.5	1 299	15 611	8.3	694	1 786
1972	2 135	19 661	10.9	1 539	18 669	8.2	596	992
1973	3 004	24 838	12.1	2 163	23 325	9.3	841	1 513
1974	3 860	31 739	12.2	2 828	31 880	8.9	1 032	- 141
1975	3 989	32 587	12.2	2 892	34 830	8.3	1 097	−2 243
1976	4 012	37 651	10.7	3 133	37 494	8.4	879	157
1977	4 327	43 684	9.9	3 556	42 332	8.4	771	1 352
1978	4 846	51 918	9.3	4 015	49 932	8.0	831	1 986
1979	6 108	64 194	9.5	4 681	62 678	7.5	1 427	1 516

[a] For 1970-79 the compound growth for agricultural exports is 15 percent, all exports 16 percent, agricultural imports 15 percent, and all imports 18 percent.

[b] Agricultural Trade includes grains and grain products, animal feed, oilseeds and oilseed products, meats and other animal products such as fur and skins, dairy products, poultry and eggs, fruits and nuts, vegetables, potatoes and products, seeds for sowing, maple products and sugar, vegetable fibers, plantation crops, and other agricultural products such as spices and fruit trees.

Source: Agriculture Canada, *Canada's Trade in Agricultural Products*, Annual.

MAJOR EXPORT AND IMPORT MARKETS

Changes in the major markets for Canada's agricultural products have occurred during the past 10 years (Table 2). The most noticeable is the decline in the United Kingdom's importance as a major outlet for Canada's agricultural exports. In 1970, Britain's share of Canada's agricultural exports was 16 percent but by 1979 it had declined 8 percent.

The contraction of the British market was not unexpected since Canada lost preferential status for its agricultural exports when Britain joined the European Economic Community (EEC) in 1973, but it was "more damaging than originally forecast in many commodity areas, many of which are important to particular regions and provinces. Commodity exports to the United Kingdom particularly hurt included oilseeds and oilseed products, edible offals, cheese, apples, processed vegetables, honey, tobacco, peas, and beans."[2]

On the other hand, Japan's share of Canada's agricultural exports increased from 12 percent in 1970 to 18 percent in 1979. In the process Japan displaced the United States as the largest single country market for Canada's agricultural exports (the EEC as a block is the largest Canadian market). Grain, rapeseed, and pork are the major commodities exported to Japan.

[2] J.S. Lohoar, "Canada's Agricultural Trade – Recent Developments and Export Prospects," *Canadian Farm Economics* 13 (August 1978).

Another shift in market distribution occurred with countries listed under the "other" category. The expansion of agricultural exports to east European countries and to high income growth countries in East Asia and the Middle East account for exports to "other" countries increasing from 26 percent in 1970 to an average of 31 percent for the 1977-79 period. Canadian agricultural exports to the Caribbean countries which are included in the "other" category, however, decreased recently as a result of the loss of the British Preferential entry terms that Canadian exporters enjoyed before the Caribbean countries become signatories to the EEC Lomé Convention.[3]

From 1970 to 1979 the United States was consistently the largest single source of agricultural imports to Canada with an average market share of 56 percent (Table 3). Australia, the EEC, New Zealand, and Mexico were also major sources for Canadian agricultural imports with a 19 percent share, while other countries supplied 25 percent of the total. In contrast to the export side, the market shares of the major suppliers of Canada's agricultural imports have remained fairly constant during the period.

[3] The Lomé Convention provides preferential access to the EEC market for developing countries. Under this agreement Caribbean countries were required to drop their British Preferential (BP) tariffs.

TABLE 2. CANADA'S MAJOR EXPORT MARKETS FOR AGRICULTURAL PRODUCTS, 1970-79

Year	United States	Japan	EEC[a]	U.K.[b]	USSR	China	Other	Total
				$ million				
1970	344	193	511	275	89	122	432	1685
(Percent of Total)	(21)	(12)	(30)	(16)	(5)	(7)	(26)	(100)
1971	332	232	632	296	115	193	497	1993
(Percent of Total)	(17)	(12)	(32)	(15)	(6)	(10)	(25)	(100)
1972	362	275	568	280	268	230	439	2135
(Percent of Total)	(17)	(13)	(27)	(13)	(13)	(11)	(21)	(100)
1973	549	539	705	328	285	192	738	3003
(Percent of Total)	(18)	(18)	(24)	(11)	(10)	(6)	(25)	(100)
1974	530	686	942	399	177	340	1345	3860
(Percent of Total)	(14)	(18)	(24)	(11)	(0)	(9)	(35)	(100)
1975	490	740	844	351	377	310	1227	3988
(Percent of Total)	(12)	(19)	(21)	(9)	(0)	(8)	(31)	(100)
1976	574	779	901	382	472	144	1138	4012
(Percent of Total)	(14)	(19)	(23)	(10)	(12)	(4)	(28)	(100)
1977	695	759	908	344	289	314	1363	4326
(Percent of Total)	(16)	(18)	(21)	(8)	(7)	(7)	(32)	(100)
1978	792	833	925	434	343	350	1602	4846
(Percent of Total)	(16)	(17)	(19)	(9)	(7)	(7)	(33)	(100)
1979	1024	1115	1342	507	434	414	1779	6108
(Percent of Total)	(17)	(18)	(22)	(8)	(7)	(7)	(29)	(100)
Average, 1970-74	423	385	672	317	155	215	690	2535
(Percent of Total)	(17)	(15)	(27)	(13)	(6)	(9)	(27)	(100)
Average, 1975-79	715	845	984	404	383	306	1422	4656
(Percent of Total)	(15)	(18)	(21)	(9)	(8)	(7)	(31)	(100)

[a]Belgium, Luxembourg, France, Italy, West Germany, Netherlands, the United Kingdom, Ireland, and Denmark.
[b]Figures for the United Kingdom are shown separately but are also included in the EEC total.

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

TRADE STRUCTURE

Exports

The values of major agricultural commodities exported and imported are expressed as percentage shares of total agricultural exports and imports in Table 4. The dominance of grains as a major export commodity as well as the steady decline in the share of grains since 1975 and the steady increase in the oilseed share is apparent. Wheat prices were low in 1976, 1977, and 1978 and the export volume fell in 1979. These circumstances contributed to the decline in grain shares in the latter part of the decade and the rapid increase in the volume of rapeseed exports caused the oilseed share to rise.

Meat exports have also enjoyed a small increase in their share of agricultural exports, mainly because of a steady growth in pork exports; however, some of this was due to an increase in meat prices. As for the other commodities, the consistency of the commodity shares is remarkable. In short, the commodity share of Canada's agricultural exports has not changed, but the market shares of major importers of Canada's agricultural products have changed significantly during the past decade.

Imports

Some decreases in shares of total agricultural imports occurred for oilseeds, live animals, and meats, while vegetable imports increased (Table 5). The absolute

TABLE 3. CANADA'S MAJOR SOURCES OF AGRICULTURAL IMPORTS, 1970-79

Year	United States	Australia	EEC	U.K.[a]	New Zealand	Mexico	Other Countries	Total
				$ million				
1970	664	89	103	46	43	34	350	1283
(Percent of Total)	(52)	(7)	(8)	(4)	(3)	(3)	(27)	(100)
1971	706	74	110	49	39	30	340	1299
(Percent of Total)	(54)	(6)	(8)	(4)	(3)	(2)	(26)	(100)
1972	812	136	124	55	41	32	393	1539
(Percent of Total)	(53)	(9)	(8)	(4)	(3)	(2)	(26)	(100)
1973	1221	186	160	68	71	42	483	2163
(Percent of Total)	(56)	(9)	(7)	(3)	(3)	(2)	(22)	(100)
1974	1578	266	190	82	75	43	676	2828
(Percent of Total)	(56)	(9)	(7)	(3)	(3)	(2)	(24)	(100)
1975	1593	236	208	94	47	39	769	2892
(Percent of Total)	(55)	(8)	(7)	(3)	(2)	(1)	(27)	(100)
1976	1832	216	222	103	68	64	731	3133
(Percent of Total)	(58)	(7)	(7)	(3)	(2)	(2)	(23)	(100)
1977	2046	190	277	132	63	98	882	3556
(Percent of Total)	(58)	(5)	(8)	(4)	(2)	(3)	(25)	(100)
1978	2302	211	319	145	92	72	1019	4015
(Percent of Total)	(57)	(5)	(8)	(4)	(2)	(2)	(25)	(100)
1979	2677	240	332	130	126	92	1213	4680
(Percent of Total)	(57)	(5)	(7)	(3)	(3)	(2)	(26)	(100)
Average, 1970-74	996	150	137	60	54	36	448	1822
(Percent of Total)	(55)	(8)	(8)	(3)	(3)	(2)	(25)	(100)
Average, 1975-74	2090	219	272	121	79	73	923	3655
(Percent of Total)	(57)	(6)	(7)	(3)	(2)	(2)	(25)	(100)

[a]Figures for the United Kingdom are shown separately, but are included in the EEC total.

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

percentage changes, however, are very small. The sharp fluctuations in import shares for plantation crops (coffee, tea, and rubber) and sugar in 1975 are a reflection of large temporary price movements more than anything else.

Trade Balance

Table 6 shows the changes in the balance of trade by commodity group. Grains (mainly wheat and barley), animal feeds, oilseeds, live animals, other animal products, and tobacco have significantly improved their net export position compared with 1970 figures, while the net export position of poultry and eggs, fruits and nuts, vegetables, vegetable fibers, and plantation crops have significantly deteriorated.

Statistical trends indicate that Canada's net trading position in the commodities where she traditionally enjoys comparative advantage has been maintained and in some cases improved, while the opposite holds true for commodities for which Canada's competitive position has not traditionally been strong. On the basis of these observed trends no major shifts in the pattern of competitiveness for major Canadian agricultural commodities has been detected during the past decade.

Processed Food Products

Table 7 focuses attention on trade in processed food products. There is a major difference between food trade and agricultural trade. Alcoholic beverages and fish and fish products are food commodities only; animal feed, grains, oilseeds, seeds for sowing, and furs and skins are agricultural commodities only. Common to both groups are commodities such as dairy products, fruits, nuts, vegetables, potatoes, sugar, tea, coffee, meats,

TABLE 4. AGRICULTURE COMMODITY EXPORTS AS PERCENTAGES OF TOTAL AGRICULTURAL EXPORTS

Product	1970	1975	1977	1978	1979
			percent		
Grains	49	63	52	49	45
Grain Products	6	5	5	5	5
Animal Feeds	3	2	3	3	3
Oilseeds	9	8	10	11	14
Oilseed Products	2	1	2	2	2
Animals, Live	4	2	3	4	4
Meats	6	4	5	6	7
Other Animal Products	5	4	6	6	7
Dairy Products	3	1	2	2	2
Poultry and Eggs	1	1	0	1	—
Fruits and Nuts	1	1	1	1	1
Vegetables	2	2	2	2	2
Potatoes	1	1	1	1	1
Seeds for Sowing	1	1	1	1	1
Maple Products	—[a]	—	—	—	—
Sugar	—	1	1	1	1
Tobacco	3	2	2	2	2
Vegetable Fibers	—	—	—	—	—
Plantation Crops (Tea and Coffee)	—	—	1	—	—
Other Agricultural Products	3	2	2	2	3

[a]— = less than 1 percent.

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

TABLE 5. AGRICULTURE COMMODITY IMPORTS AS PERCENTAGES OF TOTAL AGRICULTURAL IMPORTS

Product	1970	1975	1977	1978	1979
			percent		
Grains	3	5	2	2	3
Grain Products	2	2	2	2	2
Animal Feeds	1	1	1	1	1
Oilseeds	5	5	4	4	4
Oilseed Products	6	6	6	7	6
Animals, Live	2	2	1	1	1
Meats	9	7	8	8	7
Other Animal Products	6	5	6	6	8
Dairy Products	2	2	2	2	2
Poultry and Eggs	1	1	1	1	2
Fruits and Nuts	21	17	18	20	21
Vegetables	9	9	10	10	10
Potatoes	1	1	1	1	1
Seeds for Sowing	1	1	1	1	1
Maple Products	0[a]	0	0	0	0
Sugar	7	17	6	5	5
Tobacco	—[b]	—	—	—	—
Vegetable Fibers	4	2	2	2	2
Plantation Crops (Tea and Coffee)	14	10	19	18	17
Other Agricultural Products	7	7	7	7	7

[a] 0 = less than 1 percent.
[b]— = none.

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

TABLE 6. BALANCE OF TRADE BY COMMODITY GROUP

Group	1970	1975	1977	1978	1979
			$ million		
Agricultural Products	402	1097	771	831	1427
Grains	798	2398	2187	2301	2630
Grain Products	71	150	134	184	189
Animal Feeds	40	42	94	81	114
Oilseeds	80	204	294	390	687
Oilseed Products	−49	−147	−125	−155	−158
Animals, Live	35	9	∓105	∓139	176
Meats	−8	−28	−73	−22	96
Other Animal Products	12	15	59	71	76
Dairy Products	31	−11	28	15	41
Poultry and Eggs	−4	−13	−32	−32	−48
Fruits and Nuts	−242	−460	−605	−751	−897
Vegetables	−84	−204	−275	−336	−364
Potatoes	5	7	−4	−7	10
Seeds for Sowing	6	−3	−4	−9	−20
Maple Products	+6	6	10	11	15
Sugar	−85	−456	−189	−165	−200
Tobacco	49	57	55	+89	129
Vegetable Fibers	−45	−53	−79	−87	−108
Plantation Crops	−172	−289	−658	−707	−769
Other Agricultural Products	−39	−128	−153	−176	−170

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

TABLE 7. FOOD TRADE[a]

Year	Food Exports[b]	Food Imports	Balance of Trade
		$ million	
1970	643	527	116
1971	681	539	142
1972	765	695	70
1973	1126	959	167
1974	1051	1155	−104
1975	1136	1203	−67
1976	1391	1448	−57
1977	1781	1671	110
1978	2213	1969	244

[a]Food trade includes fish and fish products, grain products, meats, dairy products, poultry and eggs, fruits and nuts, vegetables, potatoes and products, maple products, sugar, plantation crops, wines, whiskeys and other beverages and other food products such as chewing gum, spices, and peanut butter.

[b]For 1970-78 the compound growth rate for food exports is 15 percent and for food imports 16 percent.

Source: Industry, Trade and Commerce, "Manufacturing Trade and Measures, 1966-78," July 1979.

eggs, and grain products. During 1970-78[4] the growth rate of processed food exports was 15 percent and of processed food imports 16 percent. These figures are identical to the growth rates for total agricultural exports and imports calculated for the same period. The share of processed and manufactured goods in Canada's agricultural trade has therefore remained unchanged for exports as well as for imports during the past nine years.

[4]Data for 1979 are not available.

FOOD AID

Table 8 provides a perspective on Canadian food aid

TABLE 8. FOOD AID, VALUE OF CANADIAN AGRICULTURAL EXPORTS TO DEVELOPING COUNTRIES, 1970-78

Exports	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
					$ million					
Total Agricultural Exports to Developing Countries	444	568	535	724	1399	1213	932	1340	1549	1667
Total Food Aid to Developing Countries	68	65	63	89	124	177	169	175	161	161
Estimated Commercial Sales	376	503	472	635	1275	1036	763	1165	1388	1506
(Commercial Sales as a Percentage of Total Agricultural Exports)	(85)	(89)	(88)	(88)	(91)	(85)	(92)	(86)	(90)	(90)

Sources: External Trade Division, Statistics Canada, *Trade of Canada — Exports to Countries*; Food Aid Coordination and Evaluation Division, CIDA, Annual Bi-lateral Food Aid Data; International Liaison Service, Agriculture Canada, Annual Multilateral Food Aid Data.

TABLE 9. AGRICULTURAL IMPORTS

Year	Supplementary (1)	Complementary (2)	(2) ÷ (3)	Total (3)
	— $'000	—	— % —	— $'000 —
1970	898 960	384 168	30	1 283 128
1971	902 629	396 386	31	1 299 015
1972	1 109 762	428 322	28	1 538 084
1973	1 641 544	521 436	24	2 162 980
1974	2 243 153	585 259	21	2 828 412
1975	2 268 889	622 790	22	2 891 679
1976	2 344 930	784 324	25	3 129 254
1977	2 399 098	1 156 711	33	3 555 809
1978	2 737 530	1 277 510	32	4 015 040
1979	3 245 765	1 434 750	31	4 680 515

Source: Agriculture Canada, *Canada's Trade in Agricultural Products,* Annual.

to developing countries.[5] Food aid comprises approximately 10 percent of Canada's agricultural exports to developing countries and this proportion has changed little during the past nine years. The value of food aid, however, has more than doubled during the period. (Commodities which Canada exports as food aid include wheat, flour, oilseed products, milk powder, and meat.)

COMPLEMENTARY AND SUPPLEMENTARY IMPORTS

Another aspect of Canada's agricultural trade structure is the importance of the complementary import component of total agricultural imports.

[5]For a more detailed discussion see Diana Wisner, "Canada's Agricultural Trade with Developing Countries," *Canadian Farm Economics* 15 (February 1980).

Complementary imports are products which are not produced in Canada, such as bananas, tea, and coffee. Supplementary imports are products similar to or the same as agricultural commodities produced commercially in Canada, and which compete with commodities produced in Canada. Complementary agricultural imports are therefore primarily non-competing imports, i.e., imports with little if any substitution possibilities from domestic sources.

Table 9 shows that the percentage of complementary imports in total agricultural imports has ranged from a low of 21 percent to a high of 33 percent. During the 1976-79 period the value of complementary imports increased 83.4 percent and the value of the supplementary imports climbed 38 percent. Consequently, the percentage share of complementary imports increased from 25 to 30 percent. This indicates that Canadians are consuming more agricultural products that are not

readily produced in Canada while relying more on domestic production to substitute for supplementary imports, a process probably bolstered by the 19 percent depreciation of the Canadian dollar relative to the U.S. dollar during this period.

SUMMARY AND CONCLUSIONS

According to statistical trends, the fundamental structure of Canada's trade in agricultural products during the past decade has not changed significantly except for some changes in market shares among major importers of Canada's agricultural products.

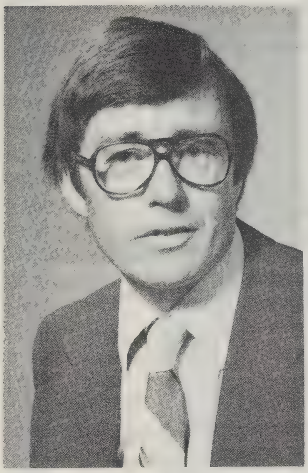
Japan has displaced the United States as the biggest importer of Canadian agricultural products and Britain's market share has almost been halved during the past decade. At the same time, Caribbean countries are importing fewer agricultural products from Canada while East European, Middle East and some East Asian countries are importing more.

On a net basis, the Canadian share of the world market for agricultural products has therefore decreased slightly during the 1970-79 period. The EEC's aggressive export pricing through extensive use of export subsidies, the loss of traditional markets as a result of restructuring of international trading arrangements in the British and the Caribbean markets, and the initiation and the slow adjustement process that characterizes the development of emerging new markets are possible explanations for the relatively slow expansion of Canada's agricultural exports during the past decade.

In the latter part of the past decade (1976-79) the Canadian dollar depreciated 19 percent relative to the U.S. dollar, 63 percent against the German mark, and 64 percent relative to the Japanese yen. This represents a substantial reduction in the price of Canadian goods in foreign currency, and to the extent that the devaluation-induced price competitiveness is not whittled down by cost increases, the size of the domestic agricultural industry should tend to expand as a direct result of increased exports and better opportunities for import substitution.

During the past decade, oil-exporting developing countries and the fast-growing East Asian economies have achieved a much higher level of income growth. This has led to higher import levels. In addition, the successful conclusion of the Tokyo Round of Multilateral Trade Negotiations (MTN) in 1979 has resulted in concessions that will favorably affect more than $1 billion worth of Canadian agricultural exports. On the basis of the increased price competitiveness through the dollar depreciation, an expansion in the size of the world market because of high income growth rates and increased oil revenues in food deficit countries, and a freer trade environment created by the successful MTN, the forecast for further expansion of Canadian agricultural exports is favorable. However, such expansion must be based on the efficient production of agricultural output. Consequently, it is necessary, through careful study and analysis, to identify agricultural products which Canada can produce relatively more efficiently than her trading partners, and to develop existing and potential markets for these products through a well-planned marketing strategy.

STRUCTURAL ADJUSTMENT IN THE ONTARIO DAIRY FARM SECTOR, 1971-76



Between 1971 and 1976 more than 15 000 dairy farm operators gave up their dairy enterprises in Ontario. Of these, 53 percent retired from farming while 47 percent adjusted from dairy to non-dairy farming – mainly to cattle and small grain farms. During the same period there were 5000 new dairy farm operators, of whom 74 percent were not farm operators in 1971. The net effect was a 33 percent decline in the number of dairy farm operators – giving a 1976 total of 20 440 operators.

*J.R. Cumming**

INTRODUCTION

The authors of a recent article in Canadian Farm Economics wrote about structural adjustment in the Quebec dairy farm sector between 1971 and 1976.[1] This paper looks at structural adjustment in the Ontario dairy farm sector for the same period using the same data source, the 1971-76 Agricultural Census Match. Details of the Match's mechanics and quality can be found in the appendix of Tung and McClatchy[2] and in an unpublished mimeograph by Bollman.[3]

Strutural adjustment for three groups of dairy farmer in 1971 is examined in the paper. The farmers include 1. continuing dairy farmers (operators who were dairy farmers in 1971 and in 1976),[4] 2. adjusting-out dairy farmers (farmers with a dairy enterprise in 1971 but not in 1976, although still farming), and 3. exiting dairy farmers (dairy farmers in 1971 who were not farming in 1976). Figure 1 contains a list of adjustment alternatives available to Ontario farmers.

Information reported and examined in this article relates to the following:

- The general pattern of growth, stability, and contraction of continuing dairy farmers, and of dairy farmer adjustment and exit out of dairy farming by dairy herd size.
- The farm resource structure and adjustments of dairy and non-dairy farms occurring between 1971 and 1976. Farm resources include average land holdings according to land use, numbers, and type of livestock, dairy herd size, and milk production level. Other farm related factors, such as the value of agricultural products sold (gross sales) and the farmer's age, are also considered.
- Structural adjustment of 1971 dairy farmers by region. The regions used are those set up by the

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[1] F.L. Tung and D. McClatchy, "Structural Adjustment in the Quebec Dairy Farm Sector, 1971-76," *Canadian Farm Economics* 15 (February 1980).

[2] Ibid.

[3] R.D. Bollman, "1966-71 Census of Agriculture Match: Methodology and Analysis of the Quality of the Match," unpublished mimeograph, Agriculture Division, Statistics Canada, April 1977.

[4] A dairy farm is one reporting three or more cows and heifers used for milk, while a non-dairy farm is one with fewer than three cows and heifers kept for milk.

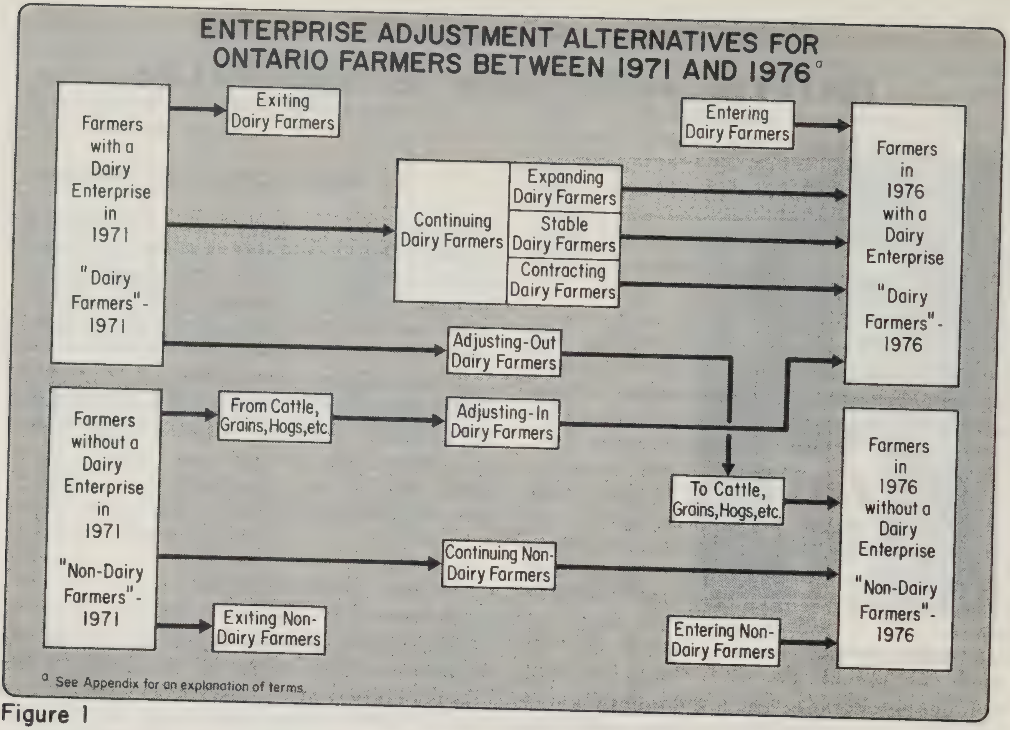

Figure 1

Ontario Ministry of Agriculture and Food (Region 1– Southern Ontario, Region 2 – Western Ontario, Region 3 – Central Ontario, Region 4 – Eastern Ontario, and Region 5 – Northern Ontario.)[5]

OVERVIEW

From 1971 to 1976 the total number of Ontario census farms declined more than 6 percent – from 94 635 to 88 715. At the same time the number of dairy farms decreased 33 percent – from 30 515 to 20 440. Thus, while the total number of farms declined by less than 6000, the number of dairy farms decreased more than 10 000, and the number of non-dairy farms increased more than 6 percent, or about 4000 farms.

Within these summary statistics considerable adjustment occurred. Farmers entered and left farming and also altered the size and resource structure of their operations. Changes in production emphasis also occurred with farms adjusting-in and adjusting-out of the dairy sector (Table 1).

Of the 94 635 census farmers in 1971, 34 550, or 36.5 percent, had left farming by 1976. During the same period, 28 625 farmers began farming, raising the 1976 total to 88 715 census farmers. Within the dairy sector, of the 30 515 dairy farms in 1971, 15 430, or a little more than 50 percent, continued as dairy farms in 1976, while more than 7000 dairy farmers adjusted to non-dairy and almost 8000 dairy farmers left farming. Of the almost 5000 new dairy farmers, 26 percent adjusted-in from non-dairy farming and 74 percent were new entrants to farming. This decline in dairy farm numbers was not accompanied by a proportional decrease in the total provincial number of milk cows,[6]

[5]For the geographic boundaries of these regions see Ministry of Agriculture and Food, Agricultural Statistics for Ontario, 1976, Toronto, p. ii.

[6]Milk cows includes milk cows and milk heifers. The total number of milk cows fell from 741 060 in 1971 to 662 364 in 1976, an 11 percent decline.

TABLE 1. MOVEMENT OF FARM OPERATORS BETWEEN THE 1971 AND 1976 CENSUS YEARS BY DAIRY HERD SIZE, ONTARIO[a]

Farm Classification in 1971	Total No. of Farms (1971)	Exits (Not Farm Operators in 1976)	Farm Classification in 1976: Non-Dairy Farms	3-17 Dairy Cows	18-47 Dairy Cows	48-92 Dairy Cows	93 & Over Dairy Cows	Sub-total Dairy Farms	Total No. of Farms (1976)
Non-Dairy Farms	64 120	26 565	36 265	750	440	85	10	1 285	37 560
Dairy Farms									
3-17 Dairy Cows	12 895	4 050	4 700	3 085	1 020	30	–[b]	4 135	8 845
18-47 Dairy Cows	14 740	3 350	2 135	875	6 815	1 525	35	9 250	11 390
48-92 Dairy Cows	2 650	525	225	30	395	1 310	165	1 900	2 130
93+ Dairy Cows	230	60	25	–[b]	5	40	100	145	175
Subtotal Dairy	30 515	7 985	7 085	3 990	8 235	2 905	300	15 430	22 540
Total No. of Farms (1971)	94 635	34 550	43 350	4 740	8 675	2 990	310	16 715	60 100
Entries (Not Farm Operators in 1971)	–	–	24 930	1 085	1 880	675	65	3 705	28 625
Total No. of Farms in 1976	–	–	68 280	5 840	10 560	3 665	375	20 440	88 715

[a]Farms classified as institutional are excluded. Total farm operators may not be equal to numbers shown in census publications because of adjustments for confidentiality. Some small discrepancies exist in totals because of rounding.
[b]The hyphen (–) denotes zero or less than three farm operators.

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

for which the average herd size rose from 24 to 32 cows during the 1971-76 period.

The Ontario provincial trend was similar to that noted for Quebec by Tung and McClatchy. There the percentage of dairy farms declined, 30 percent between 1971 and 1976, while the total number of farms declined 16 percent and the percentage of non-dairy farms increased 10 percent. This pattern suggests that the adjustment process away from dairy farming between 1971 and 1976 proceeded at a slightly faster rate in Ontario than in Quebec. One area of difference between the two provinces was in the percentage of entering farmers entering the dairy sector. In Ontario about 13 percent of entering farmers entered dairy farming; the corresponding figure for Quebec was 36 percent.[7]

Examination of the continuing dairy farms by dairy cow herd size reveals that the number of 48-92 and 93+ cow herds increased, while the number of 3-17 and 18-47 dairy cow herds declined. Within these continuing dairy farms, 73 percent remained in the same herd size group in 1976 as in 1971. There was movement, however, towards larger and smaller herd sizes. For the 18-47 cow herd group almost twice as many herds moved to the 48-92 and 93+ cow herd groups as to the 3-17 cow herd size. For the 48-92 cow herd size the opposite was true; more than twice as many herds moved into the 3-17 and 18-47 cow herd groups than into the 93+ cow herd group.

The 1971-76 provincial and regional adjustments between the various dairy and non-dairy groups are summarized in Table 2. In 1971 about 19 percent of the farms in Region 1 were dairy farms. In Regions 2, 3, and 5 about 35 percent of farms were dairy farms while the figure for Region 4 was 53 percent. Between 1971 and 1976 the percentage of dairy farms declined by amounts ranging from 5 percent in Region 1 to 15 percent in Region 4.

The regional adjustment patterns are similar to the province's. The total number of farms between 1971 and 1976, apart from Region 5, declined up to 7 percent. The number of non-dairy farms, apart from Region

[7]However, in 1976 more than 53 percent of Quebec farms reported a dairy enterprise; the corresponding figure for Ontario was 23 percent.

TABLE 2. CHANGES IN FARM STRUCTURE FOR TOTAL DAIRY[a] AND NON-DAIRY FARMS, ONTARIO, 1971-76

Period and Type of Farm	Region 1	Region 2	Region 3	Region 4	Region 5	Province
1971						
Total Farms	32 695	28 045	14 615	15 400	3 890	94 635
Non-Dairy Farms	26 570	17 935	9 850	7 210	2 565	64 120
Dairy Farms	6 120	10 106	4 765	8 195	1 330	30 515
1971-76						
Continuing as Non-Dairy Farms	16 215	10 095	4 995	3 610	1 350	36 265
Continuing as Dairy Farms	3 060	5 200	2 185	4 345	615	15 430
Exiting - Dairy	10 075	7 430	4 595	3 360	1 115	25 565
Exiting - Non-Dairy	1 585	2 505	1 335	2 170	390	7 985
Adjusting from Dairy to Non-Dairy	1 465	2 380	1 235	1 675	325	7 085
Adjusting from Non-Dairy to Dairy	275	405	270	235	95	1 285
Entered Farming (Non-Dairy)	8 515	6 880	4 500	3 555	1 480	24 930
Entered Farming (Dairy)	745	1 175	605	905	265	3 705
1976						
Total Farms	30 295	26 165	13 790	14 340	4 130	88 715
Non-Dairy Farms	26 200	19 345	10 735	8 835	3 160	68 280
Dairy Farms	4 095	6 815	3 045	5 495	975	20 440
Total Farms 76/71 (%)	92.7	93.3	94.4	93.1	106.2	93.7
Non-Dairy Farms	98.6	107.9	109.0	122.5	123.2	106.5
Dairy Farms 76/71 (%)	66.9	67.4	63.9	67.1	73.3	67.0

[a]Three or more milk cows.

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

1, increased while the number of dairy farms declined between 26 and 36 percent from the 1971 totals. The major structural difference between the regions is the smaller percentage of total farms as dairy farms in Region 1. This suggests that structural changes, i.e., the drop in the number and percentage of dairy farms, have been ongoing in that region for some time. However, the rate of decline in dairy farms in Region 1 is still similar to that of other regions, indicating that adjustment is still underway in that region.

CONTINUING DAIRY FARMERS, 1971-76

More than 15 000 farms can be identified as continuing dairy farms, i.e., those having dairy enterprises in both 1971 and 1976. Of these, more than 73 percent were in the same herd size group in 1976 as in 1971, while 18 percent expanded their dairy herd size to a larger herd size group and 9 percent reduced their dairy herd to a smaller herd size group.

Table 3 examines the continuing dairy farms by size of herd and resource structure in 1971 and 1976, and identifies the stable, contracting, and expanding dairy farms. Four important conclusions can be drawn from this information. First, the expanding dairy farms had larger quantities of improved land, total cattle, milk cows, and total sales in 1971 than stable dairy farms, while contracting dairy farms had smaller quantities of improved land, total cattle, milk cows, and total sales than stable dairy farms. This suggests that the expansion or contraction of the farm enterprise, and particularly the dairy enterprise, occurring during 1971-76, was underway in 1971, and the expansion of cow numbers was preceded by expansion of other farm resources.

TABLE 3. CONTINUING DAIRY FARMS BY HERD SIZE AND RESOURCE STRUCTURE, 1971 AND 1976, ONTARIO

Resources	No. of Dairy Cows													
	3-17	3-17	3-17[a]	18-47	18-47	18-47	18-47	48-92	48-92	48-92	48-92	93+[a]	93+	93+
1971														
Total Land (ac)	165	182	197	206	215	273	328	307	316	344	456	579	583	629
Improved Land	101	122	151	138	157	210	279	196	242	268	341	398	460	515
Cropland (incl. forage)	69	88	107	95	114	155	214	139	177	203	273	244	357	391
Forage	38	49	58	57	69	94	108	88	112	128	162	145	228	247
Improved Pasture	27	29	37	38	37	48	57	52	57	57	60	138	93	113
Unimproved Land	64	60	46	68	59	63	49	111	75	76	115	181	123	114
Total Cattle (av)	35	43	52	53	60	79	112	97	96	107	138	205	186	242
Milk Cows-Heifers (av)	13	18	25	29	38	50	54	70	71	77	92	146	139	188
Cows-Heifers Milked	8	10	8	16	22	29	28	34	36	42	52	64	67	90
Av Milk per Cow-Heifer (lb)	31.8	36.0	40.5	34.2	38.1	39.3	40.0	35.1	37.9	38.6	38.6	37.0	35.5	36.7
Gross Sales ($)	7 510	9 660	16 610	10 880	15 710	21 890	50 370	24 440	27 470	32 960	42 170	52 930	63 840	123 580
Off-Farm Work (days)	49	61	74	28	18	16	54	20	12	11	14	0	5	9
Age (years)	51	44	—	50	45	43	39	48	45	44	44	40	47	46
1976	No. of Dairy Cows													
	3-17	18-47	48-92	3-17	18-47	48-92	93+	3-17	18-47	48-92	93+	18-47	48-92	93+
Total Land	165	210	311	193	229	324	456	225	304	377	572	312	653	683
Improved Land	104	149	243	133	171	257	395	157	242	302	457	284	530	581
Cropland (incl. forage)	74	112	196	98	134	210	319	131	187	245	375	209	430	483
Forage	44	69	134	60	86	136	208	72	120	161	246	92	258	321
Improved Pasture	25	32	39	30	32	39	61	23	46	49	74	67	89	85
Unimproved Land	61	61	68	60	58	67	61	68	62	75	115	28	123	102
Total Cattle (av)	37	58	102	45	67	104	188	55	88	123	197	95	160	279
Milk Cows-Heifers (av)	12	31	74	16	42	73	149	19	53	85	145	53	101	202
Cows-Heifers Milked	7	17	38	8	24	40	67	6	31	47	75	25	58	104
Av. Milk per Cow-Heifer (lb)	34.7	37.9	40.3	37.3	40.3	40.5	38.3	31.8	41.2	40.8	41.3	35.9	39.7	38.7
Gross Sales ($)	13 432	24 056	50 403	17 144	35 184	57 919	103 882	32 348	51 080	74 239	113 451	50 250	99 487	130 350
Off-Farm Work (days)	40	28	12	31	11	6	19	43	12	7	9	0	16	11
Age (years)	55	49	45	55	49	47	40	54	49	49	48	50	50	49
No. of Farms	3 085	1 020	30	875	6 815	1 525	35	30	395	1 310	165	5	40	100

[a]No dairy farms expanded from the 3-17 cow herd size (1971) to the 93+ cow herd size (1976) or contracted from the 93+ cow herd size (1971) to the 3-17 cow herd size (1976).

Source: Statistics Canada, 1971-76 Agricultural Census Match Data.

Second, expanding dairy farmers are on the average younger than stable dairy farmers, and contracting dairy farmers are on the average older than stable dairy farmers.[8] In addition, the expanding farmers have higher levels of milk per cow than stable dairy farmers, who in turn have higher levels of milk per cow than contracting dairy farmers. This suggests a dairy age cycle in which young, starting dairy farmers with small herds, using superior production techniques and technology to attain higher milk yields, expand their dairy enterprises to some peak size. The expansion is followed by periods of stability and contraction before retirement.

Third, expanding dairy farmers generally did more off-farm work in 1971 than stable dairy farmers. However, contracting dairy farmers in 1971 also, on the average, did more off-farm work than stable dairy farmers. The average number of days of off-farm work for the continuing dairy farmers in all herd sizes declined from 27 days in 1971 to 18 days in 1976. This suggests that the stable, continuing dairy farm, because of its slightly larger average size, requires more on-farm work or that stable, continuing dairy farmers do not have the same financial need to work off the farm as do expanding or contracting dairy farmers.

Fourth, continuing dairy farmers in the same herd size group had, on the average, more non-dairy cattle in 1976 than in 1971. While the degree of difference is not large it indicates some movement toward a less specialized operation, possibly in response to surplus land or labor resources available on the farm.

An examination of regional patterns produces limited variation among continuing dairy farmers by region. However, farm growth between 1971 and 1976 is apparent. Average improved land bases (1971) are similar in all regions except Region 5, where larger acreages were reported. Average numbers of dairy cows and numbers of cows milked were similar for all regions in 1971 and 1976. The average ratio of cows milked to total cows by region remained constant, indicating limited, if any, improvement in this management indicator.

The value of agricultural product sold was highest for Region 1 and generally declined through Regions 2, 5, 3, and 4. To some degree the lower levels of farm sales in Regions 3, 4, and 5 were offset by larger amounts of off-farm work, and presumably off-farm income.

[8]While the average age of all farmers in 1971 was 49 years, which was unchanged in 1976, the average age (1971) of all continuing dairy farmers was 46 years.

ADJUSTING-OUT DAIRY FARMERS

Between 1971 and 1976 more than 7000 farms were identified as adjusting from dairy to non-dairy farming. This section examines adjusting-out dairy farmers in terms of the new 1976 major farm enterprise, and the resource adjustment from 1971 dairy farm enterprises to 1976 non-dairy farm enterprises.

Table 4 lists adjusting-out dairy farms by major enterprise in 1976. Clearly the most important alternative for adjusting-out farmers was cattle, with almost 60 percent classified as farms in which most of the income in 1976 came from cattle.

This adjustment alternative is not surprising considering that dairy and beef cows are interchangeable at the margin, that expertise with dairy cattle is highly relevant to beef cattle, and that many farm facilities, including feed production machinery, can be directly used in both beef and dairy farming. As well, the trend towards beef enterprises was more pronounced with the smaller dairy enterprises in which the amount of specialized dairy equipment would be limited.

The second most popular alternative was small grains – corn, barley, oats, etc., – which accounted for more than 18 percent of the new farm enterprises. Here a significant number of enterprises grew out of the larger 1971 dairy operations, i.e., those with a larger land base to put down to grain.

Hogs was the third most popular alternative, accounting for approximately 6 percent of new enterprises. This alternative can be viewed in the context of the pork sector's general buoyancy in 1975-76, the trend towards greater acreages of corn and soybeans (the staple diet of Ontario hogs), and the development of totally confined hog production techniques requiring limited amounts of land for the production facilities. These three alternatives – beef cattle, small grains, and hogs – plus the mixed livestock group account for almost 89 percent of the 1971 adjusting-out dairy farms.

These adjustment alternatives are similar to those noted for Quebec by Tung and McClatchy[9] who found 40.1 percent of adjusting-out dairy farmers adjusting to cattle, 8.8 percent to hogs, 16.2 percent to small grains, and 2.7 percent to mixed livestock. The major variation in the provincial adjustment patterns occurs in the cattle alternative, which was much more prominent in Ontario than in Quebec.

[9]Tung and McClatchy, ibid.

TABLE 4. NUMBER AND DISTRIBUTION OF ADJUSTING-OUT DAIRY FARMS BY PRODUCT TYPE, ONTARIO (1976)

Type of Farm	Herd Size (No. of Cows) 3-17	18-47	48-92	93+	Total
	No. of Farms				
Cattle	2 645	1 050	90	10	3 795
Hogs	255	125	5	5	390
Small Grains	610	500	75	10	1 195
Mixed Livestock	210	75	5	–	290
Other[a]	450	215	35	–	700
Total	4 165	1 975	215	25	6 380

[a]"Other" includes poultry, wheat, other field crops, fruit and vegetables, miscellaneous speciality, mixed field crops, other mixed, and other type farms.

The 6380 farms used in this table had three or more milk cows and heifers in 1971 and zero milk cows and heifers in 1976. In addition, there were approximately 715 (1971) dairy farms which had one or two milk cows and heifers in 1976; these are classed as non-dairy.

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

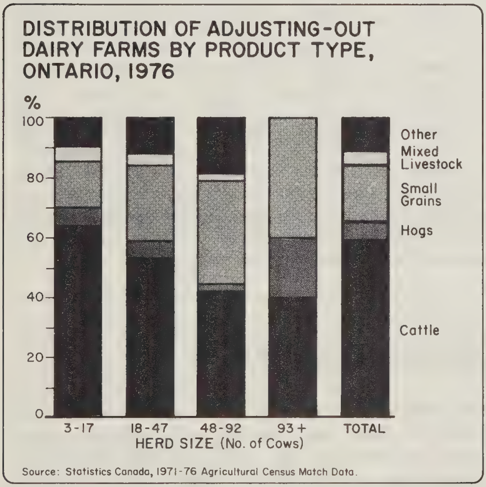

Figure 2

The 3-17 cow and 18-47 cow herd categories account for more than 96 percent of the changes in farm enterprise. Thus, although the two larger cow herd groups (48-92 and 93+) involve greater numbers of animals and more farm resources, there are fewer of them and their impact should not be overestimated.

Regional adjustment patterns from dairy to non-dairy are shown in Table 5. Regional variation is considerable, indicating to some degree the variety of alternative agriculture opportunities available within the region. Region 1 shows a marked trend towards small grain farms because of highly productive soils, favorable climate, and newly developed varieties of grains and oilseeds recommended for the region. Cattle and hog enterprises are also significant alternatives.

TABLE 5. CHANGE IN FARM OPERATION FROM DAIRY (1971)[a] TO NON-DAIRY[b] FARMS BY TYPE OF MAJOR FARM ENTERPRISE (1976), ONTARIO, BY REGION[c]

Enterprise	Region 1	2	3	4	5	Ontario
	No. of Farms					
Cattle	465	1 295	770	1 070	195	3 790
Hogs	100	200	55	40	–	390
Small Grains	470	340	165	175	35	1 195
Mixed Livestock	100	110	45	35	10	290
Other	140	185	120	225	25	705
Total	1 275	2 130	1 155	1 545	265	6 370

[a]Three or more milk cows.
[b]No cows.
[c]Regions are as follows: 1 — Southern Ontario, 2 — Western Ontario, 3 — Central Ontario, 4 — Eastern Ontario, and 5 — Northern Ontario.

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

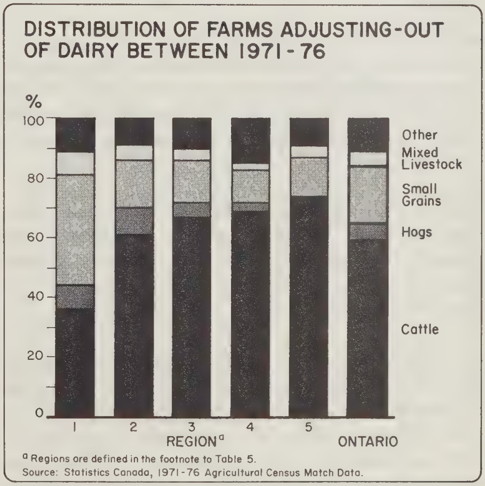

Figure 3

Region 2, which has a much more varied land base, conforms more to the provincial pattern, with 60 percent of adjusting-out farms converting to cattle opera-

TABLE 6. SELECTED CHARACTERISTICS OF 1976 SMALL GRAIN, CATTLE, AND HOG FARMS AND CORRESPONDING 1971 DAIRY FARMS BY 1971 DAIRY HERD SIZE, ONTARIO

Resources	Small Grains[a] - 1976			Cattle[a] - 1976			Hogs[a] - 1976	
	3-17	18-47	48-92	3-17	18-47	48-92	3-17	18-47
1971								
Total Land (ac)	162	227	344	193	260	377	131	202
Total Improved Land (ac)	126	184	287	104	160	274	101	164
Cropland (incl. forage ac)	99	145	231	67	105	187	77	126
Forage (ac)	34	64	124	42	67	123	30	58
Pasture Improved (ac)	20	33	46	31	49	78	20	31
Unimproved Land (ac)	36	43	57	89	99	103	30	38
Total Cattle (av)	27	57	98	40	67	124	31	59
Cows-Heifers (av)[b]	12	37	73	14	30	66	11	29
Av Cows-Heifers Milked Yesterday	5	21	41	5	15	35	5	19
Milk per Cow Milked (lb)	34.2	36.6	37.4	29.4	35.4	38.1	37.4	36.6
Milk Cows-Heifers (av)	11	31	61	11	23	76	12	34
Days Off-farm Work	60	22	16	82	35	35	67	26
Gross Sales ($)	9 770	18 650	33 790	7 400	13 570	37 090	11 910	19 910
Total Pigs							94	105
1976								
Total Land (ac)	159	210	282	183	231	308	124	169
Total Improved Land (ac)	131	178	239	102	142	223	101	139
Cropland (incl. forage ac)	116	162	222	66	97	164	84	121
Forage (ac)	27	42	62	47	66	109	29	40
Pasture Improved (ac)	8	9	8	30	40	50	12	13
Unimproved Land (ac)	28	31	43	81	89	85	23	30
Total Cattle (av)	8	13	17	43	62	117	20	30
Cows-Heifers (av)[b]	2	3	4	14	19	27	5	7
Days Off-farm Work	63	49	31	78	54	46	61	38
Gross Sales ($)	4 666	24 787	32 646	9 504	16 409	32 027	27 807	41 271
Total Pigs							149	227
Number of Farms	610	500	75	2 645	1 050	90	255	125

[a]Small numbers of farms in the 93+ dairy herd size group for Small Grains and Cattle and the 48-92 and 93+ dairy herd size group for Hogs have been omitted for greater overall clarity. The number of farms omitted can be ascertained from Table 4.
[b]Cows-Heifers (av) are all at least two years of age. Milk cows-heifers included heifers under two years of age.

Source: Statistics Canada, ***1971-76 Agricultural Census Match Data.***

tions while 16 percent adjusted to small grains. Hog farms are again prominent, mainly in Huron, Perth, Waterloo, and Wellington Counties where local corn and soybeans can be utilized. Nearly two thirds of Ontario's farms are in Regions 1 and 2.

In Regions 3, 4, and 5, two thirds of adjusting-out dairy farmers converted to cattle operations. The total combination of cattle and small grain enterprises in these regions accounts for more than 80 percent of farm adjustments; other enterprises, including hogs, make up the remaining 20 percent.

The adjustment in farm focus from dairy to non-dairy was accompanied by adjustments in average farm resources. These resource changes are shown in Table 6.

Adjusting-Out to Small Grains

On farms adjusting from dairy to small grain enterprises the total land base for each herd size declined up to 18 percent of the 1971 level. The decrease was mostly due to losses in improved land, specifically in improved pasture. Cropland acreages declined for the 48-92 cow herd but increased for the smaller herd sizes. The total number of cattle declined as expected, although cows and heifers were still reported in all sizes of the 1976 herd groupings.

Days of off-farm work increased between 1971 and 1976 for each size of 1971 herd group. This increase ranged from 3 days for the 3-17 cow herd group to 47 days for the 18-47 cow herd group. The number of

days of off-farm work was largest for the 3-17 cow herd group and smallest for the 48-92 cow herd group. Both these trends were as expected, given the essentially seasonal nature of a grain enterprise.

Farm product sales data, which take no account of production costs, showed increasing gross farm sales in nominal terms. While the increased number of days of off-farm work would augment net farm income, the net income effect of the adjustment is not clear.

Adjusting-Out to Cattle

In farms adjusting from dairy to cattle operations a pattern of total land base decline occurred similar to that found in farms adjusting to small grain enterprises. Most of the decrease was attributable to losses in improved land, specifically improved pasture, but losses in unimproved land also accounted for some of the decline. This loss is surprising given the summer grazing requirements of a cattle operation.

The total number of cattle declined for each dairy herd size with an adjustment away from the predominant cow herd to the wider range of cattle types found, for example, in a cow and calf-feeder operation. Because animals in a cattle enterprise require less time than those in a dairy operation, days of off-farm work were expected to increase. This pattern was verified for the 18-47 and 48-92 cow herd groups, but the opposite, i.e., fewer days of off-farm work, was found in the smallest dairy cow herd group. The explanation may be in the function of the older operator who wishes to remain in livestock farming but ease his total work load.

Farm product sales for each of the dairy cow herd groups increased in nomial terms. As with the grain enterprises, lack of expense information did not permit a comparison between 1971 and 1976 net farm incomes on either a nominal or real basis.

Adjusting-Out to Hogs

Land base trends in farms adjusting from dairy to hog operations showed declines in land acreages similar to those found in small grain and cattle operations. Farms in the 48-92 and 93+ dairy cow herd groups were not included in Table 6 because of their small numbers. However, the general pattern of resource adjustment in these groups is not unlike that in the 3-17 and 18-47 dairy cow herd groups.

The acreage of forage land, improved pasture, and unimproved land all declined as expected, since hogs are not free-ranging animals. The total number of cattle declined for all sizes of herd group, although a significant number of cattle, including non-dairy cows, was retained in all herd groups. Pig numbers increased, but not to the extent that might have been expected. The number of pigs on 1971 dairy farms suggests, as does the number of expanding and contracting, continuing dairy farms, that the adjustment towards specializing in hogs was a gradual one which began before 1971.

No distinct trend was apparent for the number of days of off-farm work. The 1976 level of gross farm sales for hog operations was generally higher than that of the corresponding small grain and cattle operations. However, the lack of relevant production cost data prevents further interpretation of gross farm sales for this option.

Regional Characteristics of Adjusting-Out Farmers

An examination of adjusting-out dairy farms by region generated some interesting observations. Given similar average numbers of cattle and milk cows per farm in all regions in 1971, average gross farm sales for 1971 in Regions 1 and 2 were twice those in Regions 3, 4, and 5. The 1976 average gross farm sales for the adjusting-out farms in Regions 1 and 2 were more than twice those in Regions 3, 4, and 5.

The land base for 1971 and 1976 showed similar average amounts of improved land per farm in Regions 1, 2, and 5. These amounts were approximately 20 percent higher than those for Regions 3 and 4. Region 5's improved land base would be offset by its reduced productive capacity, compared with Regions 1 and 2. The average total land base per farm for all regions except Region 1 declined between 1971 and 1976.

Levels of off-farm work for 1971 and 1976 varied from 40 to 50 days in Regions 1 and 2 and were lower than levels in Regions 3, 4, and 5 – which ranged from 69 to 86 days. It thus appears that more intensive use of the land base in Regions 1 and 2, based on adjustments into hogs and small grains, led to higher farm sales in Regions 1 and 2 than in Regions 3, 4, and 5.

Other Characteristics of Adjusting-Out Farmers

The average age in 1971 of all adjusting-out dairy farmers and of those choosing the small grain and cattle options was 50 years (Table 7).

TABLE 7. AVERAGE AGE OF SELECTED GROUPS OF FARMERS (1971) ADJUSTING OUT OF DAIRY TO NON-DAIRY FARMS, ONTARIO, BY HERD SIZE (1971) AND MAJOR ENTERPRISE (1976)

Enterprise (1976)	1971 Herd Size (No.) 3-17	18-47	48-92	93+	Total
			Age		
Cattle	51	49	46	52	50
Hogs	47	45	42	48	46
Small Grains	52	48	45	46	50
Total	51	48	46	47	50

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

Farmers who adjusted-out to cattle and small grain operations were the same age and, on the average, four years older than those who adjusted-out to hog operations. By herd size, farmers in the 3-17 dairy cow herd group were approximately four years older than those in the larger dairy cow herd groups. When compared with the average ages of 46 years for continuing dairy farmers, 35 years for entering dairy farmers, and 53 years for exiting dairy farmers, the average age of 50 for adjusting-out dairy farmers could be interpreted as a step in gradual phasing out towards retirement. By contrast, the younger age of the farmer adjusting-out of dairy into hogs could be indicative of a type of farmer who is seeking a different farming challenge, perhaps one with fewer production quota restrictions or market price constraints.

Farmers adjusting-out to cattle or small grains apparently made little, if any, increase in nominal terms in gross farm sales. Farmers adjusting to hogs, on the other hand, more than doubled their gross farm sales. However, as these data ignore farm expenses, the net farm income difference could vary considerably among commodities and over time.

EXITING DAIRY FARMERS

Between 1971 and 1976 almost 8000 dairy farmers left farming (Table 1). Their average age was 53 years. Of these exiting dairy farmers almost 51 percent were from the 3-17 dairy cow herd group while 42 percent were from the 18-47 dairy cow herd group. Compared with continuing dairy farmers, of which 42 percent were in the 3-17 dairy cow herd group and 48 percent in the 18-47 dairy cow herd group, a larger percentage of smaller dairy farmers left than continued dairy farming.

The 1971 resource characteristics of exiting farmers were similar in regional pattern to those of adjusting-out dairy farmers. Sales were highest in Regions 1 and 2 and fell through Regions 3, 5, and 4. The average land base was similar in Regions 1 through 4 and greater in Region 5. However, Region 5's increased land base would compensate only for reduced productivity levels rather than indicate increased potential for greater crop and forage output. Numbers of total cattle and dairy cows were again similar in Regions 1, 2, 3, and 5. The lower numbers in Region 4 are reflected in lower levels of gross farm sales.

Of the exiting dairy farmers, 51 percent were over 55 years of age (1971) and can be viewed as retiring or as continuing with a limited amount of part-time work. Eight percent were under 35 years of age. Since most of the farmers in this group reported no off-farm work they can be viewed as retiring from farming to take up non-farm work. The remaining 41 percent, between 35 and 55, were in the middle of their prime working years when they exited from farming. As most of this 41 percent reported either limited amounts of off-farm work, or none, the question arises why these full-time farmers exited not only from dairy operations but from farming altogether. Data currently available from the Census Match do not permit an examination of this age group of exiting dairy farmers by size of dairy herd and farm sales. Such data may reveal farm operations with resource bases which were too small to generate sufficient farm sales and provide adequate net farm incomes.

An examination of data on off-farm employment showed that more than 73 percent of exiting dairy farmers reported no off-farm work while another 5 percent reported a limited amount. However, more than 13 percent reported between 25 and 227 days of off-farm work and 8 percent reported more than 227 days, which can be viewed as full-time off-farm employment. While available data do not allow farmers to be matched by days of off-farm work and size of dairy operation, the question does arise as to how well a farmer working for considerable periods off the farm could manage a dairy operation with its irregular time requirements in terms of breeding, calving, putting up feed at optimal times, and general herd supervision. Poor herd performance caused by lack of attention to these tasks at required times would contribute to the decision to leave farming.

SUMMARY COMPARISONS OF CONTINUING DAIRY, ADJUSTING-OUT OF DAIRY, AND EXITING DAIRY FARMERS

TABLE 8. COMPARISON OF 1976 FARM ENTERPRISE ALTERNATIVES WITH 1971 DAIRY FARM ENTERPRISES (ALL HERD SIZES), ONTARIO

Resources	Enterprise Adjustment 1971-76				
	Exiting Dairy	Adjusting to Cattle	Adjusting to Small Grains	Adjusting to Hogs	Continuing Dairy
1971					
Total Land (ac)	190	216	205	167	229
Improved Land	132	124	164	131	165
Cropland (incl. forage)	93	81	129	99	120
Forage	55	51	54	43	72
Improved Pasture	33	38	28	24	39
Unimproved land	58	92	41	36	64
Total Cattle (av)	47	50	46	43	63
Milk Cows - Heifers (av)	28	19	27	22	39
Cows - Heifers Milked	15	8	15	11	22
Av Milk per Cow - Heifer (lb)	36.9	35.4	35.3	35.6	37.2
Gross Sales ($)	12 180	9 990	15 610	16 130	17 010
Off-Farm Work (days)	37	68	41	53	27
Age (years)	53	50	50	46	46
1976					
Total Land (ac)	—[a]	200	192	146	245
Improved Land	—	117	161	119	183
Cropland (incl. forage)	—	77	145	100	143
Forage	—	54	36	35	91
Improved Pasture	—	34	9	12	34
Unimproved Land	—	83	31	27	62
Total Cattle (av)	—	50	11	26	72
Milk Cows - Heifers (lb)	—	1	—	1	43
Cows - Heifers Milked	—	—	—	—	24
Av Milk per Cow - Heifer (lb)	—	—	—	—	40.3
Gross Sales ($)	—	12 131	20 605	33 829	36 873
Off-Farm Work (days)	—	70	54	53	18
Age (years)	—	55	54	50	50
No. of Farms	7 985	3 795	1 195	390	15 430

[a]A dash (—) means no record or fewer than three farms.

Source: Statistics Canada, *1971-76 Agricultural Census Match Data.*

In 1971 there were more than 30 000 dairy farmers in Ontario. By 1976 approximately 8000 had left farming and more than 7000 had adjusted-out of dairy to non-dairy farming. More than 15 000 farmers were continuing dairy farming. Table 8 examines the resource adjustments between 1971 and 1976 of exiting dairy farmers, three groups of adjusting-out dairy farmers, and continuing dairy farmers for all herd sizes.

The average continuing dairy farmer was younger than the adjusting-out dairy farmer, with the exception of those adjusting-out into hogs, while the adjusting-out dairy farmers were younger than those leaving farming. In addition, continuing dairy farmers worked fewer days off the farm in 1971 than did adjusting-out or exiting dairy farmers. From 1971 to 1976 the difference in numbers of days worked off the farm increased between continuing dairy and adjusting-out dairy farmers. This would result from the increased average size of continuing dairy farms and the greater off-farm work flexibility permitted adjusted-out farmers.

The total cattle numbers of exiting and adjusting-out dairy farmers in 1971, while similar, were about 25 percent less than the total cattle numbers of continuing dairy farmers. The difference is reflected in the larger average number of milk cows owned by the continuing dairy farmers. Farmers adjusting-out to cattle had the largest number of non-dairy cows, part of their adjustment to a principally cattle operation.

The 1971 total land base, on the average, was greatest for continuing dairy farmers. In contrast, farmers adjusting-out of dairy to hogs generally had the smallest

total land base, appropriate for what would be in 1976 an intensive hog operation. Farmers adjusting-out of dairy to small grains on the average had the greatest area of improved land not in forage while farmers adjusting-out to cattle had the largest unimproved land area. It thus appears that the enterprise adjustments out of dairy, which culminated in 1971-76, were preceded by farm resource adjustments, some of which occurred before 1971, which indicated the direction of the farm adjustment.

Farm sales in terms of the value of agricultural products sold were greatest for continuing dairy farmers who on the average had the largest farms and highest milk yields per cow. They were slightly lower for farmers adjusting-out to hogs and small grains, for whom dairy sales were significantly supplemented by hog and grain sales, lower again for smaller exiting dairy farmers, and lowest for farmers adjusting-out to cattle.

Between 1971 and 1976 the total average land base of continuing dairy farmers had increased while that of the three adjusting-out-of-dairy options had declined. Livestock adjustments were appropriate to the farm adjustments taken by the various groups of farmer. Farm sales for continuing dairy farmers and farmers adjusting-out to hogs more than doubled, while increases for farmers adjusting-out to small grains and cattle were much more limited, even in nominal terms. This limited increase was to some extent a result of lower production costs which were not reflected in higher farm sales in the case of the small grain option, or in the case of the cattle option, a reflection of the low point in a commodity price cycle.

The averages in Table 8 were derived by combining all dairy cow herd size groups. If the 3-17 and 18-47 dairy cow herd groups (1971) are examined separately, and the continuing dairy farmers subdivided into contracting, stable, and expanding dairy farms, then the above observations can be examined in more detail. There are too few of the exiting dairy and adjusting-out dairy farmers in the 48-92 and 93+ dairy cow herd groups to permit meaningful analysis.[10]

For the 3-17 dairy cow herds in 1971, the total land base was greatest for adjusting-out cattle farmers; average improved land was greatest for farmers adjusting-out of small grains. Total average cattle and numbers of milk cows were greatest for the expanding, continuing dairy farmers. The average amount of milk per cow was lowest for the farmers adjusting-out to cattle and in the stable, continuing dairy category, and highest for the farmers adjusting-out to hogs. Farm sales were greatest for farmers adjusting-out to hogs and similar for the farmers adjusting-out to small grains and expanding, continuing dairy farmers. Farmers adjusting-out to hogs and small grains clearly did not leave dairy farming because they were inferior dairy producers, but because they probably considered that alternative enterprises had more financial potential and were more closely suited to their personal goals.

While expanding, continuing dairy farmers increased their total land base between 1971 and 1976, the other options marginally contracted their total land bases. Other resource adjustments were generally in line with those shown in Table 8. Acreages of unimproved land were greatest for farmers adjusting-out to cattle. Increases in farm sales were lower for options adjusting-out to cattle and small grains and for stable, continuing dairy farms than for farms adjusting-out to hogs and expanding, continuing dairy farms.

An examination of the 18-47 dairy cow herds (1971), which included the contracting, continuing dairy farm option, produced conclusions similar to those arrived at for the 3-17 dairy cow herd group. Total land area for all groups, except stable and expanding, continuing dairy farms, declined between 1971 and 1976. Farm sales more than doubled for farmers adjusting-out to hogs; stable, continuing farmers; and expanding, continuing dairy farmers; but the increase was not as great for farmers adjusting-out to small grains. Lower production costs for small grains, relative to those for adjusting-out to hogs and for stable and expanding, continuing dairy farm operations, probably generate net farm incomes on the small grain farms similar to those generated on the other farm options. Days of off-farm work increased during the 1971-76 period for options adjusting-out of dairy and declined for continuing dairy options.

Two major conclusions can be drawn from this information. First, a farm's 1971 resource mix tended to influence the decision to adjust or not during the next five years and, if adjustment did take place, its direction. Second, while farmers adjusting-out of dairy might appear to be less well off financially than continuing dairy farmers after adjustment, for certain adjustment options, when compared with 1971 dairy farms of similar size, this was not necessarily true. Factors such as changed production costs associated with other than dairy enterprises and increased off-farm work do not

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[10] Of the 7085 adjusting-out dairy farms, 3.5 percent had more than 47 dairy cows while 7.3 percent of the 7985 exiting dairy farms had more than 47 dairy cows (Table 1).

permit specific conclusions concerning the relative net farm incomes of continuing and adjusting-out dairy farmers. However, data do suggest that farmers adjusting-out to hogs and small grain farmers would have net farm incomes in 1976 similar to those of stable, continuing dairy farmers from the same 1971 dairy cow herd group.

CONCLUSIONS AND DISCUSSION

Ontario dairy farmers in 1971 had three broad options. They could continue as dairy farmers, exit from farming altogether, or adjust out of dairy into non-dairy enterprises. Between 1971 and 1976 more than 15 000 farmers left dairy farming; 47 percent took up a non-dairy farm enterprise, and the remaining 53 percent left farming. Of this 53 percent, the 18 percent who were more than 60 years of age probably retired from the work force, leaving 35 percent to seek full-time, off-farm employment. The loss of these 15 000 adjusting-out or exiting dairy farmers was partly offset by the entrance of approximately 5000 new dairy farmers. Of these entering dairy farmers, some were inter-generational transfers, some had a farm background but had not taken over the family farm, some had no farm background, and some were non-dairy farmers adjusting into dairy. The net effect during the 1971-76 period was a one-third decline in the total number of dairy farmers.

This study suggested other general conclusions which should be viewed in the context of a constantly changing agricultural system. (The shortcomings of the Census Match data must also be taken into consideration, some of which are outlined in the Tung and McClatchy and Bollman studies.) The conclusions derived from the present study are as follows:

- The 1971-76 farm enterprise adjustments – whether adjustments out of dairy, or growth, or contraction of the dairy enterprise – were gradual, with resource adjustments preceding the actual switch in commodity production emphasis by several years.
- Farmers who expanded their dairy enterprise, or who adjusted to a non-dairy enterprise which would generate sales similar to those of stable or expanding dairy enterprises, were younger than those farmers who contracted their dairy enterprise or adjusted-out to a non-dairy enterprise with a low level of sales.
- Farmers adjusting out of dairy to non-dairy contracted their total farm acreages between 1971 and 1976. This conclusion applies specifically to farmers adjusting-out to cattle and small grain farms.
- Days of off-farm work declined for stable and expanding, continuing dairy farmers. Conversely, days of off-farm work increased for contracting, continuing dairy farmers and for adjusting-out dairy farmers.
- Expanding, continuing dairy farmers were the most productive in terms of milk production per cow. Dairy farmers adjusting-out to cattle, exiting dairy, and stable, continuing dairy farmers at the 3-17 dairy cow herd level were the least productive. Larger herds were more productive than small ones.
- No improvement was found in the ratio of cows milked to the average number of milk cows and heifers, either provincially or regionally. An improvement in this ratio would indicate improved farm management in the area of breeding.
- Increases in the value of agricultural product sold between 1971 and 1976 were largest for stable and expanding, continuing dairy farmers and farmers adjusting-out to hogs, and least for adjusting-out dairy farmers other than those adjusting-out to hogs or small grains. However, the lack of production cost data and off-farm income information does not allow accurate estimates of net income to be made. Regionally, the average farm gross sales were greatest for Region 1 and generally decreased through to Region 5.
- Of the adjusting-out dairy farmers the majority adjusted to cattle operations, with small grain and hog enterprises being significant alternatives. Small grain farms were prominent adjustment alternatives in Region 1, while adjustment to hogs was emphasized in Regions 1 and 2.

Structural adjusments that occurred in the Ontario dairy farm sector between 1971 and 1976 have been outlined in this paper. Similar degrees of adjustment are expected during the 1976-81 period. The basic reasons for such adjustment were noted by Tung and McClatchy for Quebec and also apply, perhaps to a lesser degree, to Ontario. Dairy farms are expected to become larger through increased numbers of more productive cows, and are expected to employ more modern technology, and to devise ways of allowing the operator and other members of the permanent labor force to be relieved from milking duty so that they are not tied to the farm seven days a week.

In addition, changes in the location of the dairy sector will occur. Because fluid milk is required on a regional basis to supply local markets, fluid milk producing farms will have to be located in the vicinity of larger residential areas. Industrial milk, however, is not re-

quired on such a regional basis. With the highest quality farmland in demand for cash crop production, industrial milk production will gravitate to land of intermediate quality which is suitable for the production of quality forages and pasture. In Ontario, for example, industrial milk production will become more concentrated in the northern counties of Western Ontario and in Central and Eastern Ontario.

This study has concentrated on farmers with a dairy enterprise in 1971 and on the enterprise and resource adjustments of these farmers during the 1971-76 period. It suggests that many older dairy farmers appear to make an adjustment to a "less work and less income situation" (perhaps before retiring from farming) either by contracting the size of their dairy operation or by adjusting-out of dairy to a non-dairy type farm. Although this study provides information on the adjustments made by these farmers and speculates on their success, it provides no conclusive evidence. At the same time, the paper poses many questions about the reasons behind observed adjustments, questions which cannot be answered without further analysis of available data. Future work, while examining the underlying reasons for observed trends, could proceed in three broad areas. These would 1. compare the financial success of adjusting-out and continuing dairy farmers, 2. examine the relationship between levels of off-farm work and various farm enterprise options, i.e., to determine how off-farm work can be dovetailed to meet the requirements of various farm enterprise alternatives, and 3. compare the resource structures of continuing dairy farmers with those of entering and adjusting-in dairy farmers. Such a study would provide a better picture of the resource adjustments of all categories of dairy farmer which could then be viewed in the context of the dynamic Ontario farm sector.

APPENDIX

Figure 1 outlines the adjustment alternatives available to Ontario farmers. This appendix provides definitions of these adjustment alternatives.

Dairy Farmers: Farmers with a dairy enterprise in 1971 or 1976.

Non-Dairy Farmers: Farmers without a dairy enterprise in 1971 or 1976.

Exiting Farmers: Farming in 1971 and not farming in 1976.

Entering Farmers: Not farming in 1971 and farming in 1976.

Continuing Dairy Farmers: Farmers with a dairy enterprise in 1971 and 1976. This group can be subdivided into the following:

Stable – in the same herd size group in 1971 and 1976.

Expanding – in a larger herd size group in 1976 than in 1971.

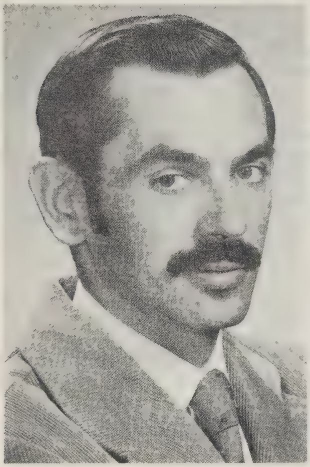
Contracting – in a smaller herd size group in 1976 than in 1971.

Adjusting-Out Dairy Farmers: Farmers with a dairy enterprise in 1971 but without one in 1976, although still farming. For example, a farmer adjusting-out to hogs had a dairy enterprise in 1971 and, while still farming in 1976, had no dairy enterprise but generated the majority of farm gross sales from a hog enterprise.

Adjusting-In Dairy Farmers: Farmers without a dairy enterprise in 1971 but with a dairy enterprise in 1976.

Continuing Non-Dairy Farmers: Farmers without a dairy enterprise in 1971 and 1976.

MARKETING TRENDS AND PATTERNS IN THE CANADIAN FLORICULTURE INDUSTRY



In 1955 the wholesale value of the Canadian floriculture crop was about $12.4 million. It now exceeds $106 million. While the number of producers is being consolidated, the area under production is increasing.

*R.W. Anderson and R. Daniel**

INTRODUCTION

Although early records are limited, Canada's floriculture industry was in existence well before World War I. After World War II the industry began to grow. An indication of the size of Canada's industry became evident in 1955 when the wholesale value of floriculture crops was estimated at $12.4 million. During the past 25 years the industry has grown to the extent that wholesale sales now exceed $106 million (Table 1).

Floriculture comprises cut flowers and floral arrangements, potted flowering and foliage plants, hanging baskets, bulbs, and bedding plants. These crops are produced in greenhouses (glass, plastic, or fiber glass) or hot beds using modern technology – temperature and light control, automated water and fertilizer systems, and atmosphere (CO_2) control. Recent increases in energy costs have also encouraged the adoption of thermal curtains and other energy-saving devices. This paper reviews the history of the Canadian floriculture industry, its growth and structure, trade position, and some of the problems confronting the industry.

DEMAND AND SUPPLY

Demand

The cut flowers that Canadian consumers appear to favor are roses and chrysanthemums (Table 2). Carnations were popular in the 1950s and early 1960s, but in recent years their popularity has decreased in relation to other types of cut flowers (Figure 1). Domestic carnation production has declined and carnation imports, while up, have not offset this decrease. Among potted plants, chrysanthemums, poinsettias, and azaleas are popular (Table 3). The demand for foliage plants increased significantly during the 1970s and they continue to be popular (Figure 2). The industry's recent efforts to broaden consumer demand for a wider product range appears to be working as consumers are purchasing more bedding plants and lesser known,

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TABLE 1. CANADIAN ORNAMENTAL FLOWER AND PLANT SALES, 1970-79

Year	Sales to Retail Florist	Sales to Wholesale Markets and Chains	Sales to Other Greenhouses	Exports	Public Sales	Sales to Unspecified Buyers	Total Canadian Sales
				$'000			
1970	19 499	8 568	3 217	818	8 233	4 049	44 383
1971	22 971	10 314	3 430	917	13 313	1 606	52 551
1972	26 020	13 369	3 997	844	19 180	498	63 909
1973	26 828	16 207	4 900	1 237	21 174	416	70 762
1974	32 268	21 699	5 521	1 057	26 455	457	87 457
1975	38 694	27 868	6 974	1 075	34 142	296	109 049
1976	36 865	38 056	7 006	1 003	39 343	1 962	124 234
1977	37 955	32 183	7 478	1 220	45 562	3 008	138 878
1978	40 524	37 625	7 749	1 722	47 519	3 567	153 563

Source: Statistics Canada, *Greenhouse Industry, 1970 - 1978,* Catalogue No. 22-202 Annual.

TABLE 2. CANADIAN CUT FLOWER PRODUCTION, 1970-78

Year	Chrysanthemums (Spray)	Chrysanthemums (Standard)	Carnations (Regular)	Carnations, Miniature or Spray[a]	Roses, Regular	Roses, Sweetheart[b]	Tulips	Narcissus, Daffodils	Others[c]
				$'000					
1970	15 564	10 267	20 677	–	38 812	–	2 555	3 294	6 110
1971	18 406	8 532	23 346	–	36 527	–	3 124	4 906	4 880
1972	20 166	8 587	23 209	–	40 010	–	4 215	5 320	6 699
1973	26 624	9 381	20 388	2 631	26 424	13 810	4 232	4 375	6 460
1974	26 886	8 897	19 691	3 062	23 296	16 219	4 036	4 071	6 608
1975	26 670	8 341	18 826	3 296	25 799	16 681	3 550	4 511	6 731
1976	25 564	8 198	14 856	4 267	23 708	15 463	4 304	3 823	6 480
1977	26 236	8 107	13 557	3 885	26 917	19 235	4 091	4 471	6 104
1978	31 890	6 683	10 076	3 812	29 016	19 551	4 272	4 203	6 443

[a] Included with carnations before 1973.
[b] Included with regular roses before 1973.
[c] Includes snapdragon, irises, gladioli, peonies, and various lesser known varieties.

Source: Statistics Canada, *Greenhouse Industry, 1970 - 1978,* Catalogue No. 22-202 Annual.

TABLE 3. CANADIAN POTTED PLANT PRODUCTION, 1970-78

Year	Geraniums	Chrysanthemums	Poinsettias	Lilies	Azealeas	Tropical Plants[a]	Others[b]
			$'000				
1970	3 105	2 361	937	366	215	–	2 263
1971	3 357	2 373	1 167	404	270	–	2 764
1972	3 952	2 567	1 171	504	288	2 435	2 012
1973	3 849	2 885	1 381	603	332	3 729	1 776
1974	4 438	3 319	1 525	649	351	5 991	2 283
1975	4 756	3 422	1 847	731	410	11 906	2 287
1976	5 228	3 470	2 058	794	426	20 659	2 654
1977	5 283	3 306	2 010	817	655	16 183	2 389
1978	5 423	4 346	2 258	849	580	17 894	2 455

[a] Includes tropical plants only in the 1972-74 period. Includes tropical, foliage, and green plants for the 1975-78 period.
[b] Includes all other potted plants such as African violets, roses, hydrangeas, etc.

Source: Statistics Canada, *Greenhouse Industry, 1970 - 1978,* Catalogue No. 22-202 Annual.

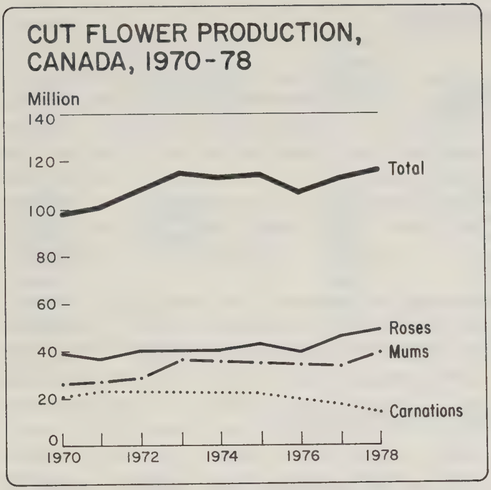

Figure 1

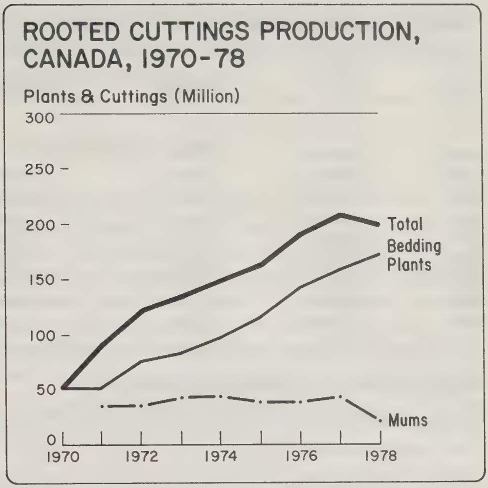

Figure 3

exotic species. Canadian rooted cutting production remained relatively stable during the 1970s, but bedding plant production escalated significantly. (See Table 4 and Figure 3.)

Supply

As expected, Canada's floriculture industry is located near the major population centers of Toronto, Montreal, and Vancouver. There is also a significant industry in southern Alberta. From 1961 to 1978 the industry experienced different growth rates in the various locations so that the current industry shares by region differ from those in 1961. For example, Ontario had 68 percent of the production area and 57 percent of the operators in 1961, compared with 63 percent of the area and 47 percent of the producers in 1978. British Columbia's share increased from 11 percent in 1961 to 15 percent in 1978. Quebec has had some growth in recent years and in 1978 accounted for 10 percent of the production area and 18 percent of the operators. While proximity to a large population is important to the industry's location, climate is also significant. Southern Ontario has a high population density and an attractive climate.

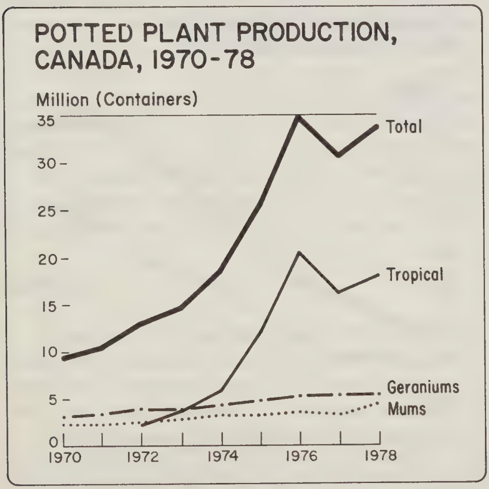

Figure 2

As with many industries, Canada's floriculture industry is experiencing a consolidation in producer numbers and an increase in the area cultivated by each grower. In the early 1960s there were slightly more than 1000 growers using approximately 150 ha to produce cut flowers, dry bulbs, and vegetables.[1] Individual holdings were small, the average operation working with an area of 0.18 ha. By 1978, some 1575 commercial greenhouse producers accounted for 370 ha, of which more than 53 percent was used in cut flower and potted plant production only. Throughout the 1970s the production area increased at an annual rate of 7 percent.

[1] Includes vegetables since early statistics did not differentiate between vegetables and flowers.

TABLE 4. CANADIAN ROOTED CUTTING PRODUCTION, 1970-78

Year	Bedding Plants	Carnations	Chrysanthemums	Hanging Baskets	Foliage and Green Plants	Others
			$'000			
1970	49 716	2 728	–	–	–	–
1971	49 452	1 505	35 053	–	–	4 192
1972	74 891	2 851	34 334	34	230	7 880
1973	81 103	2 146	42 048	72	836	6 567
1974	95 951	2 040	43 420	121	1 448	5 420
1975	114 228	2 043	38 256	445	–	6 875
1976	142 530	2 463	38 022	581	–	5 294
1977	157 446	1 274	42 156	–	–	6 100
1978	171 607	1 228	21 176	529	–	3 640

[a]Includes African violets, dracaena, hydrangeas, ivies, etc.

Source: Statistics Canada, *Greenhouse Industry, 1970 - 1978,* Catalogue No. 22-202 Annual.

In terms of specific products, tropical foliage production increased to 17.9 million units in 1978 from 2.4 million in 1972, an annual growth rate of 43.5 percent. Production increases of other potted plants averaged 20 percent annually during the same period (Table 3). Cut flower production increased only marginally (Table 2). Rose production increased from 40 to 48.6 million units and chrysanthemum production from 28.8 to 38.6 million,[2] while carnation production declined from 23.2 to 13.9 million units.

Another measure of growth is the amount of investment in the industry. From 1970 to 1978 this increased at an annual rate of 15.7 percent (Figure 4). The 1970 investment was $73.3 million, compared with $220.6 million in 1978. Much of the increased investment resulted from new energy conservation devices such as automatic shading, drip irrigation, and supplementary artificial lighting. These energy- and labor-saving technological changes have brought about some cost economies and encouraged growth.

MARKETING

As Canada's floriculture industry has been changing so have the marketing methods. Initially, the producer made most of his sales from his place of business or transported his products to specialty flower shops. More recently, mass marketing has permitted sales through retail food chain and department stores (Table 1). The necessity to move large volumes of flowers quickly has resulted in the introduction of three dutch-clock auction wholesale flower markets. Located in or near Montreal, Toronto, and Vancouver, these auctions provide an outlet for a large volume of flower products. Most growers sell some of their production through one of these auction markets. Many growers supply regular buyers and then put the rest of their crop on the open market. Each business day, flowers are received by a specific time in the morning and sold by dutch-auction shortly after. Sales are on a cash basis and help overcome the serious liquidity problem for floral producers.

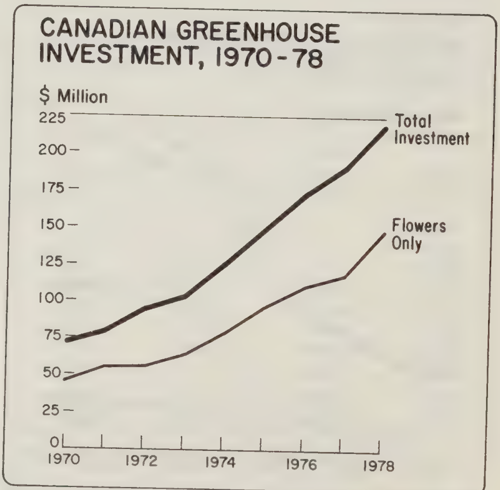

Figure 4

[2]Unit refers to a plant in a pot or container.

Toronto

The largest auction clock is the one near Toronto. Although it started only in October 1972, with 62 members, this cooperative now has more than 150 members. In its first year the value of sales was about \$1.4 million. In the second year of operation, sales increased to \$2 million and in the third year to \$3.2 million. With 1979 sales in excess of \$6 million, projected sales for 1980 could reach \$7.5 million.

Toronto's auction draws all its material from members' production. The 150 growers have a total field crop area of 20.2 ha and approximately 279 000 m^2 of heated greenhouse. The auction sales comprise approximately 30 percent flowering plants, 30 percent foliage (tropical), 20 percent cut flowers, and 20 percent bedding plants, floral greens, and miscellaneous plant products. Facilities for the auction include a large showing room and the auction room. Modern loading and receiving docks control temperatures and facilitate product movement.

Vancouver

Vancouver's auction clock is the oldest in Canada. It began in the spring of 1963 as a relatively small operation with six flower growers and total sales of \$75 000. Sales reached \$100 000 two years later and in 1979 were more than \$5.4 million. Projections for 1980 suggest sales of approximately \$6.2 million. Today the Vancouver dutch-auction cooperative has 55 full members, 22 associate members, and 16 applications for membership. Members operate about 213 900 m^2 of greenhouse, while non-members have an additional 46 500 m^2. Sales consist of approximately 33 percent flowering plants, 30 percent foliage (tropical), and 27 percent cut flowers. Bedding plants, floral greens, and miscellaneous items comprise 10 percent of total sales. Members of the cooperative do not usually sell all their products through the auction, but have the option to do so. Associate members are allowed to sell only their high quality product through the clock auction.

Montreal

A cooperative of 26 Quebec and 18 Ontario growers established Montreal's market in November 1972. Today this cooperative has 51 shareholders, 33 of which are active members, and Ontario and Quebec producers are represented in about the same proportion as in 1972. Sales in 1978-79 were \$1.76 million and are projected to be \$2.5 million in 1979-80. Approximately 50 percent of sales are cut flowers, 20 percent potted plants, and 30 percent tropical foliage. Quebec growers concentrate more on foliage plants for "growing on" than do the major areas.

TRANSPORTATION

Transportation is still a major problem for the floriculture industry. During the 1950s, rail service was used almost exclusively for product shipment. As the volume of floriculture products to be transported increased, along with that of nonfloriculture materials (both perishable and non-perishable), the quality and availability of the service for perishable products declined. As a result, damage claims increased and rates were raised for perishable commodities. This made specialized trucking attractive and, with the introduction of flower auctions, the use of fast, controlled-atmosphere trucks was widely adopted. For ensured quality and quick delivery, truck service is excellent. However, the industry is concerned about the rapid rate increases in recent years.

Air transportation played an increasingly important role in the floral industry in the 1970s. Initially, when the volume of goods sent by air was limited, floral products received special attention. But as the volume of non-floral products increased, less attention was paid to the requirements for flowers; consequently, the quality of the service declined and damage claims increased.

Floral importers have made significant use of air service, but rising costs of and competition for the available air freight space are causing difficulties. Increased transportation costs have reduced profits in the floriculture industry and made many small orders unattractive. In addition, growers and wholesalers have not been able to pass increased transportation costs on to consumers. This limits their ability to remain competitive in purchasing transportation services. As a result, the industry is facing a transportation crisis. One method of overcoming delivery problems, however, is direct sales from producers to retail chains.

TRADE

Imports and exports are also major factors in Canada's floriculture industry (Table 5). The value of imports has grown dramatically since the early 1960s when they averaged \$7–8 million a year. This value increased from an average of \$9.5 million during 1965-69 to an average of \$19 million during 1970-74 and to 61.7 million in 1979 (Figure 5).

TABLE 5. CANADIAN IMPORTS AND EXPORTS, 1970-79

Year	Imports					Exports	
	Cut Flowers	Cuttings	Bulbs	Tulip Bulbs	Gladioli Bulbs	Plants	Nursery Stock
				$'000			
1970	5 108	5 261	1 305	844	134	728	3 009
1971	5 407	5 806	1 301	880	140	1 013	2 914
1972	6 345	6 482	1 897	876	140	1 259	3 156
1973	8 549	8 597	2 156	1 036	106	2 374	2 882
1974	10 456	12 563	2 407	893	152	3 318	2 479
1975	12 355	20 626	2 573	1 002	155	3 482	2 084
1976	16 232	25 297	2 437	853	172	3 399	2 699
1977	16 424	29 589	2 900	822	139	4 306	3 421
1978	18 864	31 355	3 426	1 072	175	5 713	4 280
1979	19 707	32 951	4 513	1 218	130	5 712	5 051

[a] Includes cut flowers and decorative plant material, not elsewhere specified.
[b] Includes trees, plants, stocks, and cuttings, not elsewhere specified.
[c] Includes bulbs, tubers, and roots of flowers, not elsewhere specified.
[d] Includes plants, bulbs, and roots of flowers, not elsewhere specified.
[e] Includes nursery and greenhouse stock, not elsewhere specified.

Source: Statistics Canada, *Import by Commodities, 1970 to 1979,* Catalogue No. 65-007.

Most imports are cut flowers or stock for "growing on." Major suppliers of cut flowers in 1979 were the United States – $13.7 million, Colombia – $3.8 million, the Netherlands – $0.9 million, and Italy – $0.3 million (Table 6). The Netherlands, while being a major supplier of bulbs, tubers, and flower roots, also exports specialty cut flowers to Canada. While imports increase during the festive seasons and major holidays, the volume of imports is substantial throughout the year.

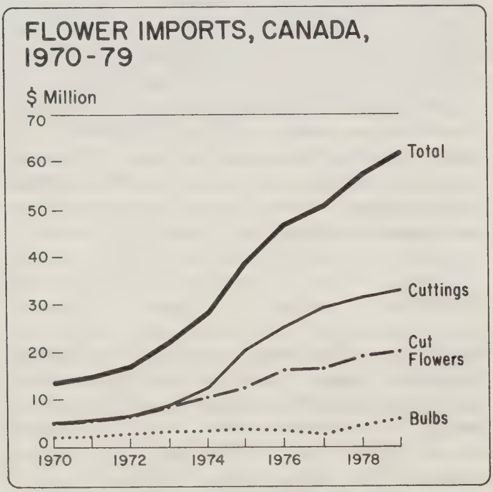

Figure 5

Exports, most of which go to the United States, have risen in value from an average of $2.4 million during the 1965-69 period to $5.7 million in 1979. Although the value has increased, exports as a percentage of imports have decreased in recent years. This is due largely to lower input costs such as labor, energy, and chemicals, and a more favorable climate in competing countries. Some of the Canadian export growth in 1978 and 1979 can be attributed to the decline in the value of the Canadian dollar relative to other currencies. Transportation costs and the value of the Canadian dollar will continue to have an impact of any future change in the export volume and may be expected to favor this trade.

Tariffs are also important in Canada's floriculture industry. They were included in the General Agreement on Tariffs and Trade (GATT) in 1948. While tariffs were "bound" against increases under this agreement, governments were allowed to lower them and further liberalize trade.[3] Through the series of Multilateral Trade Negotiations (MTN) held under the auspices of the GATT, the Canadian government has successively reduced the tariffs on some plants and flower import items. This occurred most recently in the Tokyo Round of the MTN, at which Canada agreed to further reduce the bound rates on items including gladiolus corms, rosebushes, hydrangeas, and certain pot-grown plants

[3] "Bound" refers to the agreement under the GATT whereby signatory countries could not raise the tariff without compensating its affected countries.

TABLE 6. CUT FLOWERS: VALUE OF CANADIAN IMPORTS, BY PRINCIPAL COUNTRY OF ORIGIN, 1970-79

Origin	United States		Netherlands		Colombia		Italy		All Countries
	%	$'000	%	$'000	%	$'000	%	$'000	$'000
1970	91.3	4 662	3.3	169	0.0	1	1.9	97	5 108
1971	92.1	4 981	2.7	148	0.0	0	1.8	95	5 407
1972	86.7	5 498	4.5	288	0.3	21	3.3	209	6 345
1973	84.7	7 241	5.6	476	1.2	100	2.8	242	8 549
1974	81.7	8 540	6.7	697	2.0	204	3.5	368	10 456
1975	84.2	10 399	4.7	576	3.8	464	2.8	350	12 355
1976	79.3	12 426	5.0	783	8.5	1 331	3.2	507	15 666
1977	72.9	11 967	7.9	1 301	11.9	1 952	2.2	364	16 424
1978	70.4	13 276	5.8	1 093	16.9	3 185	1.9	353	18 864
1979	69.4	13 674	4.4	873	19.7	3 878	1.4	284	19 707

Source: Statistics Canada, *Imports by Commodities, Class 21399,* Catalogue No. 65-203 for 1970-78 and Catalogue No. 65-007 for 1979.

TABLE 7. CANADIAN FLORICULTURE TARIFF RATES

Tariff Item Number	Product Description	Base Rate of Duty (Applied Rate) 1979[a]	Concession Rate of Duty 1987[b]
7802-1	Gladiolus corms, n.o.p.[c]	17½%	12.5%
7803-1	Hydrangeas and other pot-grown plants, n.o.p.; rose stock and other stock for grafting or budding, n.o.p.; bulbs, corms, tubers, rhizomes, and dormant roots, n.o.p.	12½%	10%
7804-1	Hydrangeas and other pot-grown plants, n.o.p.; rose stock and other stock for grafting or budding, n.o.p.; bulbs, corms, including gladiolus corms, tubers, rhizomes, and dormant roots, n.o.p.; dwarf polyantha rose bushes; All the foregoing for use by florists or nurserymen for *bona fide* forcing purposes or growing on before disposal	12½% (Temporarily free)	10%
7805-1	Rosebushes for use by florists or nurserymen exclusively in the production of cut flowers ..... each	3 cents (Temporarily free)	2 cents
7925-1	Mulberry trees, cuttings, roots and buds, for sericultural purposes	12½% (Temporarily free)	free
7940-1	Multiflora rosebushes	12½%	10%
7945-1	Rosebushes, n.o.p. .... each	3 cents	free

[a]These were the rates applied during 1979.
[b]These will be the new rates as of January 1, 1987. The rates are being phased in between 1979 and 1987.
[c]n.o.p. = not otherwise provided.

and bulbs (Table 7). The reduced rates are being phased in between 1979 and 1987. Several plants already enter Canada duty free – palms, ferns, rubber plants (Ficus), cannas, dahlias, peonies, rhododendrons (including azaleas), pot-grown lilacs, araucarias, and laurels. Other plant-propagating materials which florists use for "forcing" and "growing-on" also enter Canada duty free.

CONCLUSIONS AND SUMMARY

Since its inception, the Canadian floriculture industry has had to cope with problems, some of which now require further attention. The industry's dependence on energy and its high cost has created a major challenge. More efficient use of fossil energy, developments of alternative energy sources, and increased research are critical if the industry is to be viable. While research has played a major role in overcoming diseases and insects through the development of fungicides and insecticides, as well as resistant, productive, and attractive cultivars, more such research is necessary if the availability of top quality product currently being marketed is to continue. Industry members will remain concerned with plant breeders' rights. These are under government consideration and legislation may be forthcoming soon. Transportation is still a problem. Floral products, like all perishables are especially sensitive to transportation problems such as changes in temperature and delays. Consequently, efforts must be made to provide a suitable and efficient service at a cost which the industry can handle.

Canada's floriculture industry has experienced a period of substantial growth. Although challenged by import competition and such problems as energy costs and transportation, the industry should continue to grow and become an increasingly significant sector of Canadian agriculture.

ECONOMIC INDICATORS

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978 II	1978 III	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual	1980 I
Production and Income											
1. GNP at Market Prices[a]	$ mil.	226 572[b]	233 200[b]	237 968[b]	229 698[b]	247 496[b]	256 256[b]	264 712[b]	272 756[b]	260 305[b]	279 024
2. Farm Cash Receipts Total[d]	$ mil.	2 727.0[b]	2 900.3[b]	3 341.6[b]	11 899.0[b]	3 380.5[b]	3 255.0[b]	3 430.1[b]	3 904.8[b]	13 970.9[b]	3 380.5
3. – Total Crops[d]	$ mil.	1 026.4[b]	1 161.0[b]	1 248.0[b]	4 906.1[b]	1 447.3[b]	1 188.3[b]	1 464.8[b]	1 764.5[b]	5 861.3[b]	1 447.3
4. – Total Livestock[d]	$ mil.	1 612.0[b]	1 645.3[b]	1 923.7[b]	6 541.5[b]	1 861.1[b]	1 938.9[b]	1 872.3[b]	2 051.9[b]	7 724.1[b]	1 861.1
5. Net Income Rec'd by Farm Operators[a]	$ mil.	3 664.0[b]	3 076.0[b]	3 240.0[b]	3 214.0[b]	3 988.0[b]	4 348.0[b]	3 280.0[b]	4 152.0[b]	3 942.0[b]	3 412.0[b]
Trade											
6. Agricultural Exports	$ mil.	1 230.5	1 261.3[b]	1 391.8[b]	4 846.3	1 204.4	1 354.7	1 663.9	1 884.8	6 107.8	1 501.5
7. Agricultural Imports	$ mil.	1 088.5	943.2	1 104.4	4 015.06	1 129.2	1 181.6	1 129.4	1 240.4	4 680.6	1 158.9
8. Real Domestic Product, Ag[a]	1971=100	114.3[b]	117.5[b]	119.7[b]	117.8[b]	109.7[b]	104.9[b]	105.5[b]	112.4[b]	108.1[b]	111.5
9. Real Dom. Prod., Less Ag[a]	1971=100	135.1[b]	136.6[b]	138.3[b]	135.9[b]	138.3[b]	138.9[b]	140.8[b]	140.4[b]	139.6[b]	140.8
Price Indexes											
10. Farm Input Price Index	1971=100	200.2	203.2	209.2	201.1[b]	229.0[b]	233.9[b]	235.6[b]	239.1[b]	234.4[b]	253.5
11. – Buildings and Fencing	1971=100	197.6	203.1	209.9	201.0	216.1	223.2	229.5	235.3	226.0	235.5
12. – Machinery & Motor Veh.	1971=100	174.0	176.0	182.1	176.2[b]	188.0	191.8[b]	196.2[b]	205.3	193.3	214.2
13. – Crop Production	1971=100	225.5	228.3	230.2	225.5	238.6	252.5[b]	258.5[b]	266.5	254.0	296.6
14. – Animal Production	1971=100	203.7	207.3	218.2	201.8	246.8	252.3[b]	249.2[b]	247.8	249.0	252.3
15. – Hired Farm Labor	1971=100	217.9	223.9	225.4	220.4	228.0	232.8	235.7	237.8	233.6	242.1
16. – Interest	1971=100	284.5	284.5	284.5	284.5	385.1[b]	385.1[b]	385.1[b]	385.1[b]	385.1[b]	474.7
17. Farm Prices of Ag. Prod.[d]	1971=100	206.8	209.9	221.9	217.6[b]	250.3[b]	250.7	247.7[F]	246.4[F]	298.8[F]	248.7[F]
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	372.9	418.8	342.4	1 288.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	462.3	479.3	490.3	473.0	499.7[b]	497.7[b]	466.7[b]	475.3	484.9	440.7
20. Av. Farm Labor Rates	$/hr.	3.73	3.78	3.84	3.76	3.89	3.95	4.01	4.08	3.98	4.15
21. Av. Hourly Earnings-Manuf.	$/hr.	6.77	6.87	7.03	6.84[b]	7.19[b]	7.37[b]	7.50	7.68	7.44	7.90
22. F.C.C.-Gross Loan Disburs.	$ mil.	127.8	205.7	121.7	533.6	35.4	174.7	192.4	145.2	547.7	98.5
23. CPI – All Items	1971=100	173.3	177.7	180.5	175.2	184.6	189.4	193.1	197.6	191.2	202.0
24. – Food at Home	1971=100	208.3	218.7	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0	250.3
25. – Food Away from Home	1971=100	194.9	202.2	207.3	199.3	213.1	220.8	227.3	232.4	223.4	237.1
26. Industry Selling Price Index – Food & Beverage	1971=100	204.6[b]	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.3[b]	237.5	231.7	239.2

continued

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (concluded)

Item	Units or Base	1978				1979					1980
		II	III	IV	Annual	I	II	III	IV	Annual	I
Other Indicators											
27. Unemployment Rate	%	8.5[b]	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1	7.3	7.5	7.4
28. Exchange Rate	$ U.S.	1.13	1.14	1.18	1.14	1.19	1.16	1.17	1.19	1.17	1.16
29. Av. Rate on New Demand Loans	%	9.66[b]	10.03[b]	12.32	10.18	12.31	12.55	12.81	15.27	13.24	15.33
30. Quarterly Pop. Est.	mil.	23.44[b]	23.50	23.55	23.48	23.60	23.65	23.69	23.74	23.67	23.81

[a] Seasonally adjusted at annual rates.
[b] Revised.
[c] Preliminary.
[d] Excludes Newfoundland.
[e] Excluding repair parts.
[f] Based on current initial prices for wheat, oats, barley in Alberta, Saskatchewan and Manitoba.

Sources: All items from the Canadian Statistical Review, Statistics Canada, Catalogue No. 11-003 Agriculture Canada, *Marketing & Economics Branch* Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002, the Farm Credit Corporation; or the Bank of Canada Review.

NOTES

GATT: TWELFTH MEETING OF CONSULTATIVE GROUP OF EIGHTEEN

The consultative Group of Eighteen held its twelfth meeting on 15 July 1980 in Geneva. The Chairman was Mr. Olivier Long, Director-General of GATT.

The Group exchanged views on current trends and prospects in the international economy, and especially in production and trade.

It resumed its discussion, taken up at its eleventh meeting in March 1980, of GATT's role in the area of structural adjustment and trade policy.

The Group also continued to explore the contribution that GATT might make in dealing with the trade problems under discussion in the North-South dialogue.

All these matters will be further discussed at the thirteenth meeting of the Group, which will be held in October 1980.

The Consultative Group of Eighteen consists of high-level representatives, nominated by governments, with trade policy responsibilities in their countries. Its purpose is to provide GATT, on a continuing basis, with a small but representative group in which existing and emerging trade policy issues can be discussed.

The countries represented in the Consultative Group are Argentina, Australia, Brazil, Canada, Egypt, European Communities and their member States, Hungary, India, Japan, Malaysia, Nigeria, Norway, Pakistan, Peru, Spain, Switzerland, United States, and Zaire.

1980-81 DAIRY PROGRAM

On July 30, 1980, Canada's Minister of Agriculture, Eugene Whelan, announced details of the 1980-81 Government of Canada dairy program.

Effective August 1, the target returns for industrial milk are raised to $34.61 a hL ($15.26 a hundredweight) from $33.31 a hL ($14.68 a hundredweight) which was established on April 1, representing an increase of 3.9 percent.

The support price paid by the Canadian Dairy Commission to purchase butter will be raised 17 cents a kg to $3.51 (up about eight cents a pound to $1.592). The skim milk powder support price will be 12 cents a kg higher at $2.13 (up about five cents a pound to $0.966). Retail prices for these and other dairy products such as cheese, yogurt, and ice cream are expected to reflect increased milk prices paid to producers. The price of fluid milk and cream is not directly affected as the pricing of those products is a provincial responsibility.

The Government of Canada will pay a subsidy of $6.03 a hL ($2.66 a hundredweight) on industrial milk produced up to the level of domestic requirements and on milk produced for the export quota program. Canadian requirements as established by the Canadian Milk Supply Management Committee (CMSMC) remain at 44.1 million hL (100 million hundredweights), although it is expected that requirements will increase during the course of the dairy year. The government has authorized an increase in the export quota of 2.20 million hL (five million hundredweights) for 1.32 million hL (three million hundredweights) last year.

Two aspects of subsidy eligibility have been amended to achieve a greater degree of equity among producers and provinces. The minimum delivery requirement has been eliminated and maximum subsidy eligibility will no longer be limited by the effect of the volume of a producer's fluid milk shipments.

The CMSMC is currently examining proposals for a new levy structure. If a new structure is to be implemented, it must generate the same amount of dollars needed to cover export costs as the present structure does.

In reaffirming the principle of producer responsibility for the costs associated with any special production for export and for the disposal of all surplus products, the federal government will be responsible only for deficits in the export account resulting from major unforeseen changes in world market conditions and exchange rates. Further, the federal government will not be responsible for any unfinanced losses resulting from the export quota program.

Any surplus in the export account up to $10 million will be retained as a precaution against unforeseen losses in the future.

Mr. Whelan remarked on the success of the jointly funded, producer-government advertising program started in 1975-76. He stated the government will provide $2.1 million for this year, compared to $4.5

million last year. Now that demand for dairy products has stabilized, producers will be expected to totally fund their promotion programs in future years.

A budget for dairy product and market research of $1.5 million for 1980-81 has been approved. The research will focus on ways to improve products and increase the use of dairy products in the market. Studies under this program will also include dairy farm accounting projects in Ontario and Quebec and the possible effect on the domestic dairy industry of imports of imitation or filled cheese. A $2 million-a-year commitment for the next four years has been approved.

The Canadian International Development Agency (CIDA) will spend $10 million to purchase skim milk powder from the Canadian Dairy Commission for food aid programs.

The federal budget for the 1980-81 dairy year will be $297.1 million.

The following notes have been adapted from recent news releases prepared by Agriculture Canada's News Media Services.

SEED POTATO QUALITY PROGRAM ANNOUNCED

Federal funding has been approved for a federal-provincial seed quality program to assist potato growers in New Brunswick and Prince Edward Island.

The Seed Potato Quality Program will include a special insurance plan to protect growers for production, marketing, and storage risks, improved disease control and inspection services, increased seed potato research, and new market promotion efforts.

Although exports of New Brunswick and P.E.I. seed potatoes are worth about $17.5 million annually, in recent years Canada's share of the world seed potato market has declined. This new program should help the industry reestablish Canada's reputation as a producer of top quality potato seed.

The program will be jointly financed by the federal government, the provinces of New Brunswick and Prince Edward Island, and seed potato growers in the two provinces. The net increase in federal agriculture expenditures as a result of the new program will be about $1.2 million annually.

To step up the existing disease control phytosanitary inspection program, the federal and provincial governments are implementing more rigorous production and inspection controls and a mandatory system of post-harvest testing. This program is designed to provide seed potatoes that surpass the quality offered by other countries exporting seed potatoes.

Half the cost of the improved inspection program will be paid by the federal government, with the provinces paying 20 percent and the growers the remaining 30 percent.

Agriculture Canada's research program will place increased emphasis on disease detection and control, including the development of post-harvest laboratory tests to check the status of seed potato stocks. There will also be more research on whole seed production and the development of new varieties to meet market demands.

Besides improving seed potato quality, the government will be making major promotional efforts to sell more seed potatoes abroad, with the costs of these promotions shared equally by the federal and provincial governments.

A licensing system for shippers and exporters of seed potatoes will be introduced to improve marketing operations.

The new insurance plan will be voluntary. Premium costs will be shared by participating producers, provincial governments, and the federal government on a 30-20-50 basis.

AGRICULTURAL OUTLOOK CONFERENCE

The 1980 annual Agricultural Outlook Conference will be held at the Government Conference Centre in Ottawa, December 8 and 9.

The conference brings together heads of the federal and provincial departments of agriculture, and representatives from farm organizations, universities, consumer groups, agribusiness and other government departments to discuss agricultural prospects for the coming year.

Speakers will discuss general economic trends, the world agricultural and food outlook, Canadian agricultural and food market prospects in 1981, expected farm costs and incomes, and other issues important to the agriculture and food sector.

In addition to the presentation of overall outlook papers, there will be concurrent sessions dealing with

cattle and hogs, grains and oilseeds, horticultural products, poultry and eggs, dairy products, and farm costs and incomes.

NEW RETAIL SERVICE AT AGRICULTURE CANADA

Agriculture Canada is offering a new service to help Canadian food retailers. According to Ted Cochrane, who heads up the retail unit in the new section, the Retail and Food Service Industry Section was set up to improve communications between retailers, government, and other parts of the food industry. The section has concentrated its efforts so far on developments in the use of optical-reader cash registers in food stores. By monitoring the use of these computerized check-outs in retail stores across North America, it hopes to gauge the overall effect they will have in the Canadian food market.

Mr. Cochrane's staff are also studying the share of the food market held by the large food chains and independent retailers. In particular, they are considering new marketing trends, such as no-name products, and how they affect competition in the retail food business. Because people are becoming more conscious of what they get for their food dollar, the retailer must be aggressive and inventive in meeting consumer needs.

The new retail section is designed to enable the department to keep up with changes in retail marketing. It will also increase the department's involvement in the agriculture and food chain as a whole, from farmer to retailer to consumer.

Mr. Cochrane and his staff welcome comments from all segments of the food industry on ways to help the retail sector.

PUBLICATIONS

Seeds of the Earth: A Private or Public Resource? Pat Roy Mooney. 72 pages. *Published by Inter Pares (Ottawa) for the Canadian Council for International Cooperation (CCIC) and the International Coalition for Development Action (England) 1979. Reprinted, with new foreword and postscript, 1980.*

This review was prepared for CFE *by Keith Wilde, Food Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada.*

The Publishers are volunteer agencies, active and experienced at fighting hunger, disease, and poverty in Third World countries. The author is one of their associates. His subject is plant breeders' rights (PBR), and the treatment is not favorable.

In recent years, several countries have adopted PBR legislation. Its principal features are governed by an international plant patenting agreement, the International Convention for the Protection of New Varieties of Plants (UPOV). In October of 1979, Canada signed UPOV. In May of this year, the government introduced bill C-32, authorizing rights to breeders of new plant varieties. The session of parliament ended before the bill could become law.

The non-governmental organizations (NGOs) that operate through the Canadian Council for International Cooperation (CCIC) oppose the UPOV form of PBR because they believe it works against the provision of food for the hungry and poor. Furthermore, they think it will increase seed costs to farmers, food costs to consumers (by discouraging cost-saving innovations), and endanger the genetic base of food crops for the entire world.

The link between PBR and these unwanted consequences are the multinational corporations (MNC), especially giant chemical and pharmaceutical enterprises. Mooney argues that PBR encourage the concentration of all private (i.e., non-government or university) plant breeding into the hands of very few firms, whose principal interest is selling chemical products such as fertilizers and pesticides.

The justification for patents of any kind, of course, is to grant a degree of monopoly power to persons or firms who develop new products. Mooney and his associates believe that MNCs already have more power than they should have, that their innovations only accidentally benefit the poor, and that they are not reliable guardians of genetic resources on which the human future depends.

Opponents believe that extension of PBR through the UPOV will turn virtually all plant breeding over to MNCs. Corporate giants will buy up all the small companies, and encourage popular distrust of government spending, hence cutting back public breeding. They believe that the few government breeders who remain will be fully occupied with testing and certifying varieties put forward by private firms. Mooney suggests that the Green Revolution, developed mostly by public money, is being turned over to MNCs. Norman Borlaug is cited by Mooney as fearing that PBR will, through MNCs, reduce the search for important innovations in plant breeding that would not be profitable for MNCs.

Seeds of the Earth demonstrates that PBR is a very complex issue. Readers without training in botany or agronomy may find that Mooney fails to provide enough information on plant breeding and the seed business for a political economic evaluation. For such readers, the following details would be useful.

The seed business (in Europe and North America), as a trade specialty, is about 200 years old. Although plant breeding has been going on since before the dawn of civilization, PBR has been a live issue only since the 1920s.

Seeds are the basis of husbandry. Without them there would be no crop. Not all seeds are valuable, however: weeds also grow from seed. Domesticated plants produce valuable seeds because they have been selected for certain desirable characteristics over thousands of years of human intervention in their natural reproductive process.

Selective breeding of both plants and animals is an acknowledged human practice that antedates written history (see Genesis 30: 32-43). Until Charles Darwin's *Origin of Species* (1859), however, it had not generally occurred to occidental peoples that domesticated varieties of plants and animals were descended from, or related to, very different-looking wild species. Specific creation and the story of Noah's Ark was the accepted explanation, and one that was reinforced by the practical difficulty of getting fertile offspring from interspecific crosses.

Darwin introduced the idea of natural selection by first calling attention to the fact that human selection affects evolutionary change in species. Breeding animals and plants was a highly developed activity in nineteenth century England. Its effectiveness in producing change could hardly be denied.

Seed production as a commercial trade began in the late eighteenth century – an instance of the specialization of functions that was part of the Industrial Revolution. One of the most famous and successful North American plant breeders was Luther Burbank (1849-1926), who was inspired by Darwin's observations on the guidance of evolution by human selection. Although Gregor Mendel's discovery of order in genetic inheritance became general knowledge among biologists around the turn of the century, Burbank apparently never made use of it.

The Mendelian principle nonetheless initiated a new era in the human use of genetic evolution and made plant (and animal) breeding a more productive endeavor. Its application required more highly trained specialists, more sophisticated and extensive laboratory equipment, and more genetic materials from more remote places. In other words, plant breeding became more expensive as well as more productive (and necessary). The expenses entailed the familiar problem of financing science and technical development. Patent monopoly has been one way of encouraging innovators, and is the idea behind PBR.

Mooney and the CCIC would prefer to have plant breeding done at public expense, within the North American tradition; that is, at agricultural research stations and experimental farms. They point out that germ plasm is a global resource, part of the biosphere, and does not conform well to the private property system. A new seed variety cannot be patented, as a new super-steel razor blade can, because it is a living and hence a changing thing. That is why the plant breeding issue is phrased in terms of rights rather than patents. To the extent that genetic resources do lend themselves to exclusive rights, they do so on the basis of geographic location. Most of the world's food plants depend on genetic materials from a few regions of the earth, mainly in Third World countries. It is conceivable that these countries could form an OPEC-type cartel and hold many nations to ransom. Judging by recent reports like those of the Brandt Commission and The President's (U.S.) Commission on World Hunger, resentment against exploitive practices by companies based on OECD countries could inspire such a cartel.

The reports just named, and several speakers at the First Global Conference on the Future in Toronto (July 1980), aim to remind Canadians that they may be inadvertently harming the poor by actions that appear just as innocent and well-intended as PBR. Dr. Rashmi Mayur of Bombay spoke to the conference about the dumping of highly toxic and long-lasting waste materials by MNCs in poor countries – a practice arranged by bribes to key officials or politicians. He also spoke of the unfortunate effects on infant health among poor peoples of the marketing practices of MNCs selling milk products. Mooney and the CCIC would have us believe that PBR has potential consequences just as sinister, or even worse.

Political economic reasoning does not encourage us to expect universally benevolent behavior from gigantic and powerful business enterprises. Even if their domestic behavior is tamed by government regulation they may be expected to exploit opportunities abroad – sometimes with unfortunate consequences. Plant breeding is important, and big corporations have the resources to practice it. They will, however, not necessarily focus on the most important avenues of seed development, but only on those most likely to be profitable. Green Revolution varieties are of greatest interest to companies in the plant breeding business, because they are bred to thrive on the fertilizers and rely on the pesticides sold by the MNCs that have taken over most of the world seed business.

Mooney among others finds the Green Revolution a mixed blessing. It produces much grain, but the benefits do not trickle down effectively to the poor. The main reason, in his view, is that Green Revolution technology (seeds) requires so much capital (machinery, fertilizer, fuel) that only very large firms can employ it. Then the food produced must be sold abroad to affluent customers because Third World residents cannot afford to pay a cost-covering price for it.

Researchers at the Science Council of Canada have studied this issue extensively, and concluded that some aspects of Green Revolution technology may have unfortunate consequences for us, as well as for poorer nations. They worry about the destruction of our soil and the long-lasting effects of farm chemicals on the environment. The U.S. Department of Agriculture has just released a *Report and Recommendations on Organic Farming* (July 1980) which deals with the same concerns.

The kind of plant breeding effort required to resolve these environmental problems is unlikely to come from private companies. (The "public good" nature of this kind of research is well-developed, for this context, in R.C. Oelhaf's economic study, *Organic Agriculture,* published by John Wiley and Sons, New York 1978.)

It is most effectively done in publicly supported laboratories where scientists do not need rights to protect their creative efforts.

Mooney's material adds up to a good argument for more public support of plant breeding. As a case against PBR for private firms, it is less compelling. Readers may wish to consult further research on the subject which CCIC (Ottawa) has produced subsequently. They may also wish to consult the affirmative position paper of the Agricultural Institure of Canada (Ottawa).

The following eight publications are available free from the Publications Manager, Marketing and Economics Branch, Agriculture Canada, Room E-132, Sir John Carling Building, Ottawa, Ont., K1A 0C5.

Canada's Trade in Agricultural Products. G. LaBrosse, E. McSorley, Publication No. 80/3, June 1980, 71 p.

Market Commentary – Milk and Dairy Products. V. McCormick, P. Stone, M. Cluff, and G.J. Birks, June 1980, 28 p.

Specification and Evaluation of a Quarterly Forecasting Model for Grain and Oilseeds. S.N. Kulshreshtha *et al.*, Working Paper, February 1980, 103 p.

Impact of Beef Imports on the Canadian Beef Market. Ralph Lattimore and Harry De Gorter, March 1980, 108 p.

Market Commentary – Animals and Animal Products. A.M. Boswell, G.E. Pugh, P.K. Blakely, and J.G. Lussier, July 1980, 46 p.

Market Commentary – Grains and Oilseeds. C.V. Fulton, J.A. Gellner, H. Duncker, and G. Vitonova, 42 p.

Food Market Commentary. June 1980, 42 p., Cat. No. A80-751/Vol. 2, No. 2.

FARM: Food and Agriculture Regional Model, in 9 volumes: **Overview**, 16 p., **Livestock**, 24 p., **Grains and Oilseeds**, 28 p., **Dairy**, 18 p., **Poultry and Eggs**, 15 p., **Retail Demand**, 18 p., **Accounting**, 24 p., **Estimation Results**, 129 p., and **Data Appendix**, 12 p.

National Horticulture Seminar – Proceedings. Food Production and Marketing Branch, Agriculture Canada, March 1979, 113 p.

Eastern Grain Handling and Transportation Report. April 1979, 177 p. *Available free from the Canada Grains Council, Suite 500, 177 Lombard Ave., Winnipeg, Man., R3B 0W5.*

Ontario Farm Management Analysis Project 1979. Prepared by the School of Agricultural Economics and Extension Education in cooperation with the Extension Branch, Ontario Ministry of Agriculture and Food, Publication No. AEEE/80/6, July 1980, 17 p. *Available from the School of Agricultural Economics and Extension Education, Ontario Agricultural College, University of Guelph, Ont., N1G 2W1.*

Workshop on the Political Economy of Confederation – Proceedings, Kingston, Ont., Nov. 8-10, 1978. 1979, 397 p. *Available in Canada for $6.50 and outside Canada for $7.80 through authorized bookstore agents and other bookstores or by mail from the Canadian Government Publishing Centre, Supply and Services Canada, Hull, Que., K1A 0S9.*

Seeds of the Earth – A Private or Public Resource. P.R. Mooney, September 1979, 72 p. *Available for $5.00 from The Canadian Council for International Cooperation, 321 Chapel Street, Ottawa, Ont., K1N 7Z2.*

Impact of Foreign Prices and Interest Rates on Canadian Economy Under Alternative Monetary and Exchange Rate Regimes. P. Someshwar Rao and J.D. Whillans, June 1980, 150 p. *A limited number available free from the Council Secretary, Economic Council of Canada, P.O. Box 527, Ottawa, Ont., K1P 5V6.*

The following two publications are available free from the Print Media Branch, Alberta Agriculture, 9718-107 Street, Edmonton, Alta., T5K 2C8.

The Economics of Production and Marketing of Greenhouse Crops in Alberta. Economic Services Division, Production Economics Branch, AGDES 821-1, 1980, 45 p.

Know Your Machinery Costs. John Arnold and Neal Oberg, April 1980, 22 p.

The following four publications are available free from the Economics Branch, Ontario Ministry of Agriculture and Food, Legislative Buildings, Queen's Park, Toronto, Ont., M7A 1B6.

Economics Information – On-Farm Drying and Storage Costs for Corn, Ontario, 1978. G.A. Fischer, February 1980, 33 p.

Economics Information – Apple Production Costs – An Update of Standard and Size-Controlling Trees, Ontario, 1976, 1978, and 1979. E.D. McKibbon, May 1980, 11 p.

An Economics View of the Sheep Industry in Ontario. F.R. Abraham, May 1980, 31 p.

Summary of Agricultural Statistics for Ontario, 1978-1979. January 1980, 6 p.

Agricultural Statistics, 1979 Edition (N.B.). 1980, 56 p. *Available free from the New Brunswick Department of Agriculture and Rural Development, Box 6000, Fredericton, N.B., E3B 5H1.*

Saskatchewan into the Eighties. 1980, 63 p. *Available free from the Government of Saskatchewan, Information Services, Department of the Executive Council, Room 7, Legislative Building, Regina, Sask., S4S 0B3.*

The following three publications are available from the Centre for International Business Studies, Ecole des Hautes Etudes Commerciales, 5255 Decelles Avenue, Montreal, Que., H3T 1V6.

State-Trading and Domestic Distortions in a Mixed World Economy. Klaus Stegemann, June 1979, 38 p.

State-Trading and the GATT. Yvan Bernier, June 1979, 17 p.

Cooperation Among State-Trading Organizations of Developing Countries. Klaus Netter, June 1979, 15 p.

The following four publications are available from Mr. A.H. Maunder, Editor, International Association of Agricultural Economists, Darpington House, Little Clarendon Street, Oxford, England, 0X1 2HP.

Plenary and Invited Papers, 17th International Conference of Agricultural Economists, Banff, Canada, Sept. 12-13, 1979. September 1979.

Rural Change: Trends and Challenges in Canadian Agriculture. J. Harold Hanna, September 1979, 7 p.

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The following two publications are available free from the International Food Policy Research Institute, 1776 Massachusetts Avenue N.W., Washington, D.C., U.S.A., 20036.

International Food Policy Research Institute Report 1979. 1980, 36 p.

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cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
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litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
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	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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CANADIAN FARM ECONOMICS

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Agriculture Canada

HON. EUGENE WHELAN, MINISTER — GAÉTAN LUSSIER, DEPUTY MINISTER

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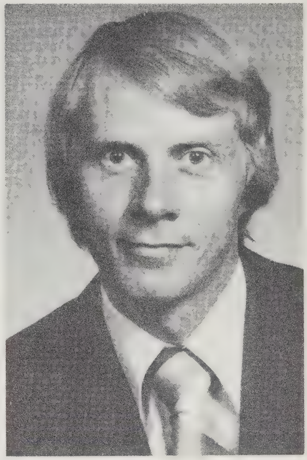
THE ECONOMICS OF OAT PRODUCTION IN THE PRAIRIE PROVINCES

Rational, economic decisions by farmers have been responsible for the recent decrease in oat production in western Canada. Oat production has not been as profitable as other cropping alternatives. The change in relative profitability results from the introduction of new crops, greater productivity increases in other cereals, and changes in crop production technology.

*B.H. Sonntag and N.D. Ketilson**



INTRODUCTION

Oats are a versatile crop. They are agronomically adapted to a wide range of agro-climatic conditions and they have many uses as food, feed, fodder, and pasture. They were once a very important crop in Canada. In recent years, however, their area and value relative to other crops have decreased.

This article describes agronomic and economic factors bearing on oat production in Canada with emphasis on the Prairie Provinces. Trends in area, yields, production, utilization, and relative prices are reviewed and major oat production areas are identified. The relative profitability of alternative cereal and oilseed cropping programs is examined, as is the subtitutability of oats for other feeds in beef feedlot diets.

HISTORICAL SIGNIFICANCE OF OATS

This section reviews trends in area, yields, production, utilization, and relative prices of oats compared with those of the principal cereal and oilseed crops in Canada.

Traditionally, oats have been grown mainly for animal feed. Although a small proportion is marketed for human consumption, most oats are used as forage or grain for animal feed, usually on the same farm where they are produced. In the early 1900s oats ranked second only to wheat in importance as a cereal crop. In the first half of the century the oat production area ranged from 30 to 50 percent of the wheat area, and represented between 20 and 30 percent of the total crop area in the Prairie Provinces. Oats were an important component of diets for horses, beef cattle, milk cows, and swine on most of the mixed grain-livestock farms that were characteristic of the pre-World War II period. The decline in the oat area coincided with the period during which prairie farms became mechanized and more specialized.

Table 1 shows the areas of selected crops for census years 1921 to 1976 in western Canada. The oat area exceeded 11 million acres in 1943 but usually fluctuated between 7 and 9 million acres until the mid-1950s. It has decreased steadily since then. In the Prairie Provinces, the oat area decreased from about 7.0 million acres in 1951 to 2.7 million acres in 1979 (Tables 1 and 2). The oat area was about 25 percent of the total crop area in western Canada in the late 1950s and only 5.8 percent in 1979. In terms of value, oats decreased in importance from 24 percent of total

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*B.H. Sonntag and N.D. Ketilson were at Agriculture Canada's Western Region Headquarters, Research Branch, Saskatoon, Saskatchewan when this article was written.

TABLE 1. AREA OF SELECTED CROPS, WESTERN CANADA, 1921-76

Province	All Wheat	Oats (Grain)	Barley	Tame Hay	Oats (Fodder)	Flax	Rapeseed
				'000 acres			
Manitoba							
1921	2 819	1 793	823	63	66	54	–
1931	2 617	1 518	1 128	296	44	101	–
1941	2 465	1 321	1 541	412	54	172	–
1951	2 149	1 481	1 876	310	47	603	–
1961	2 748	1 632	612	880	71	721	28
1971	2 429	1 338	2 001	1 022	67	549	571
1976	3 807	1 220	1 645	1 400	51	522	231
Saskatchewan							
1921	11 684	4 860	420	34	99	369	–
1931	15 026	4 295	1 375	174	118	509	–
1941	12 195	4 025	1 659	430	133	689	–
1951	13 782	3 278	2 132	476	164	273	–
1961	15 556	2 541	1 761	995	415	926	355
1971	12 706	1 889	5 480	1 604	463	919	2 689
1976	17 690	1 574	2 968	2 153	316	205	721
Alberta							
1921	4 886	2 546	391	218	160	34	–
1931	7 943	2 465	710	298	334	30	–
1941	6 556	2 857	1 579	602	258	133	–
1951	5 683	2 336	2 612	988	280	116	–
1961	5 396	2 428	2 659	2 246	483	345	273
1971	3 374	1 787	5 514	3 050	560	266	1 913
1976	5 543	1 790	5 624	3 807	499	73	740
British Columbia							
1921	41	71	6	164	24	–	–
1931	65	87	9	193	36	–	–
1941	85	94	18	260	32	3	–
1951	68	69	22	222	32	4	–
1961	78	72	53	323	30	2	–
1971	104	79	184	450	36	–	18
1976	65	87	201	621	51	–	28

Source: Statistics Canada, *Census of Agriculture.*

farm cash receipts from grain in 1960 to 3 percent in 1978.

In eastern as in western Canada, the oat area has decreased drastically (Table 3). The oat area (oats used for grain) in 1976 was roughly one-third of the 1951 area and one-fifth of the 1921 area. Oats for fodder fared somewhat better, especially in Quebec where the fodder oat area increased during the same period. Two other striking changes in crop production in eastern

TABLE 2. AREA OF SELECTED CROPS, PRAIRIE PROVINCES, 1977-79

Year	Wheat	Oats	Barley	Flax	Rapeseed
			'000 acres		
1977	24 191	4 148	11 154	1 472	3 498
1978	25 611	3 402	9 889	1 300	6 800
1979	25 201	2 701	8 499	2 291	8 199

Source: Canada Grains Council, *Canadian Grains Industry Statistical Handbook 79.*

TABLE 3. AREA OF SELECTED CROPS, EASTERN CANADA, 1921-76

Province	All Wheat	Oats (Grain)	Barley	Mixed Grain	Grain Corn	Tame Hay	Oats (Fodder)	Fodder Corn	Soybeans
					'000 acres				
Ontario									
1921	692	2851	412	547	211	3456	12	354	–
1931	634	2362	449	1012	125	3710	33	271	–
1941	611	2004	356	1156	251	3713	26	295	–
1951	747	1749	194	1081	289	3406	29	282	–
1961	514	1584	70	673	367	2787	31	256	192
1971	356	612	386	928	1263	2707	39	616	367
1976	526	464	367	813	1570	2707	56	859	373
Quebec									
1921	102	1630	105	98	14	3652	8	49	–
1931	39	1657	97	109	7	3765	50	44	–
1941	21	1586	118	172	4	3756	37	60	–
1951	12	1396	61	212	3	3654	76	80	–
1961	8	1061	17	98	5	2520	89	50	–
1971	39	695	38	123	138	2698	190	131	–
1976	77	540	46	106	154	2555	221	254	–
Maritime Provinces									
1921	52	478	15	12	–	1233	6	–	–
1931	31	452	22	26	–	1249	16	1	–
1941	16	390	41	41	–	1191	14	2	–
1951	8	337	22	87	–	1005	21	2	–
1961	5	179	4	58	–	448	9	2	–
1971	18	118	49	89	3	366	12	15	–
1976	34	108	37	93	3	444	15	29	–

Source: Statistics Canada, *Census of Agriculture.*

Canada in the last 50 years were (1) the large increase in the corn area (grain and fodder), and (2) the reduction in the total crop area. Despite these changes, oats are still the dominant cereal crop in eastern Canada.

In terms of yield change over time, oats have not performed as well as the other major cereal crops in western Canada (Table 4). During and before the 1960s, oat yields, on a weight basis, were similar to those of barley. However, in more recent years, oat yields have decreased relative to those of wheat and barley. Yield trends for rapeseed do not reflect the major alterations that have occurred in quality attributes in this crop.

TABLE 4. YIELDS OF WHEAT, BARLEY, AND RAPESEED RELATIVE TO OATS, PRAIRIE PROVINCES, 1961-79

Year	Oat Yield	Relative Yields			
		Oats	Wheat	Barley	Rapeseed
	kg/ac	–		%	–
1961-65	641	100	85	103	58
1966-70	721	100	92	113	53
1971-75	763	100	89	112	51
1976	852	100	98	115	55
1977	847	100	92	119	65
1978	807	100	100	122	63
1979	766	100	98	118	54

Source: Statistics Canada, *Handbook of Agricultural Statistics.*

The principal cereal crops differ substantially in the proportions grown on summer fallow and stubble. In the 1968-79 period, 80 percent of all wheat, 35 percent of barley, and 30 percent of oats were grown on summer fallow while the balance was grown on stubble. Average yields on stubble were roughly 77 percent of fallow yields for all three crops (Table 5).

Production trends for the major cereal and oilseed crops reflect the area and yield trends. Oats are the only major grain or oilseed whose total production has consistently decreased in recent years. The largest increases have occurred in barley and rapeseed production. The increase in barley production is especially important since barley competes directly with oats as a feed grain.

TABLE 5. CEREAL YIELDS ON FALLOW AND STUBBLE, PRAIRIE PROVINCES, 1968-78

Crop Grown On	Wheat	Oats	Barley
		kg/ac	
Fallow (F)	750	924	1030
Stubble (S)	570	720	790
S/F Ratio	.76	.78	.77

Oats are an important forage crop in western Canada, although their relative importance in the forage supply has decreased substantially in recent years (Table 1). In the past 10 years, approximately 15 percent of the total prairie oat area has been harvested as a fodder crop (6.5 percent in Manitoba, 18 percent in Saskatchewan, and 21 percent in Alberta). Oats are particularly important as a forage crop on many mixed grain-cattle farms where they account for a substantial proportion of the total hay supply. For example, studies of grain-cattle farms in southern Saskatchewan (Wiens and Kilcher 1971) found that cereal forage, principally oats, constituted more than 40 percent of the winter feed supply for cow herds in that area. The use of oats as a source of cattle feed has more flexibility than that of perennial hay because the amount harvested as hay can vary. As Wiens and Kilcher noted, a combination of the two sources of hay has advantages over a single source. Another study by Wiens (1974) confirmed the earlier findings concerning high proportions of cereal hay in cattle diets on grain-cattle farms in some areas. On a national basis, fodder oats constitute approximately 9 percent of the improved forage crop area; 80 percent of the fodder oats are produced in the Prairies, with most of the remainder produced in Quebec (Carmichael 1976).

Prices for oats relative to those of other cereals and oilseeds decreased substantially during the past 20 years. Before 1960, price relationships between oats and the major competing crops were fairly constant. Since the early 1960s prices for oats have increased less than those for competing crops.

Most of the oats grown in Canada are used for animal feed. For wheat, barley, and oats, domestic human food use represents 6, 3, and 1 percent of total supplies (Canada Grains Council 1979). Domestic demand has increased slowly with population growth while export marketings have been quite volatile. Oat exports are rather insignificant, representing only 2 percent of supplies. In prairie marketings during the past 10 years, about 63 percent of the wheat, 44 percent of the barley, and 13 percent of the oats have been delivered into the elevator system. During the same period, 5 percent of wheat, 37 percent of barley, and 64 percent of oats have been fed on farms. On the average, 84 percent of all oat supplies are either fed or stored on farms and thus never enter commercial channels.

Unlike production of some other crops, oat production is not concentrated in any particular area. Oats are grown predominantly in the Parkbelt area (Black and Grey-Wooded soil zone) of the Prairie Provinces but are widely distributed over that area. This distribution partly reflects their role in the feed supply in the mixed grain-cattle economy of the Parkbelt area.

ECONOMIC CONSIDERATIONS IN OAT PRODUCTION

Gross Value Comparisons

As suggested by the earlier figures on production and yield trends, oats remained fairly competitive with other cereals until about 1960. Gross returns per acre, estimated from Statistics Canada data on area, yields, and average farm prices show that since 1960 oats have not maintained their competitive position relative to other cereals and oilseeds (Table 6).

Both diminishing relative yields and decreasing prices contributed to this decrease. In the 1978 crop year, for example, gross returns per acre from oats were less than half of those for wheat and rapeseed.

Oats in Feeder Cattle Diets

A linear programming model developed at the Lethbridge Research Station by Sonntag and Hironaka (1974) selects feeding programs and formulates diets

TABLE 6. GROSS VALUE PER ACRE, SELECTED CROPS, PRAIRIE PROVINCES, 1921-78

Year	Wheat	Oats	Barley	Rapeseed
		$/ac		
1921-25	14.90	9.58	11.50	–
1926-30	15.30	11.00	10.10	–
1931-35	5.64	4.18	4.49	–
1936-40	8.60	5.67	7.03	–
1941-45	18.14	15.56	15.45	–
1946-50	24.03	19.17	22.70	–
1951-55	30.60	24.09	27.10	22.80
1956-60	26.64	20.36	20.56	22.93
1961-65	33.92	25.86	30.18	37.78
1966-70	35.88	27.36	30.05	38.11
1971-75	77.90	56.84	68.19	75.39
1976	88.41	61.94	80.50	126.28
1977	81.69	51.57	78.48	158.00
1978	118.14	52.47	73.74	135.88

Source: Statistics Canada, *Handbook of Agricultural Statistics.*

for feeder cattle that lead to maximum net returns over feed, feeder, and financing costs. The model was used to calculate the price relationships under which oats are competitive with other grains, as well as protein supplements, and forages in feeder cattle diets.

In the analysis for this article, feeds other than barley, wheat, and oats were set at constant prices representative of late 1979 conditions. For example, all hay was priced at $66/t, straw at $44/t, and rapeseed meal at $233/t. Prices for barley varied from $57.40 to $94.69/t. The wheat price was maintained at about 20 percent more than that for barley on a unit-weight basis. Nutrient composition figures for the feed ingredients were obtained from the Alberta feed test laboratory and the National Research Council (1976).

Least-cost diets for feeder steers were formulated for three price situations; they are presented as Case I in Table 7. With low grain prices, the entire energy needs of the feeder were supplied most economically by barley. As the barley price was increased relative to those of forages, some substitution of forage for barley occurred. The oat competitive price, or the price at which oats would substitute for barley, was about 93 percent on a unit-weight basis. In the period from 1961 to 1979, the average farm price of oats in the Prairie Provinces was above this level in most years from 1965 to 1974 and below in the other years.

In Case II, oats were priced at or slightly less than the competitive price derived in Case I. Diets were formulated and oats completely replaced barley in the grain portion of the diet. This indicates that cost-competitive and nutritionally adequate feedlot diets can be formulated with oats as the only grain when price relationships are appropriate. However, as the next section illustrates, oat production is not highly profitable at this price level.

TABLE 7. SAMPLE FEEDLOT DIETS FOR THREE PRICES OF FEED GRAINS

Items	Price Situation 1	2	3
Case I			
Barley price ($/t)	58	80	103
Oat price ($/t)	58	80	103
Diet composition (%)			
Barley	98.6	88.7	71.4
Oats	–	–	–
Oat straw	–	10.1	17.1
Alfalfa hay	–	–	10.8
Limestone	1.1	.9	.4
Salt	.2	.2	.2
Oat competitive price ($/t)	54	75	96
Case II[a]			
Diet composition (%)			
Barley	–	–	–
Oats	98.9	86.7	84.0
Oat straw	–	12.4	12.7
Alfalfa hay	–	–	2.5
Limestone	.8	.7	.6
Salt	.2	.2	.2

[a]Barley prices identical to Case I; oats priced fractionally lower than oat competitive price derived in Case I.

Relative Profitability of Alternative Cropping Programs

A simulation model for dryland cereal and oilseed production on farms in the Canadian Prairies was used to compare cropping programs with and without oats (Zentner, *et al.* 1978). For this analysis the model was used as a computerized farm budget where several alternative production plans – rotation, crop combination, fertilizer application rates, etc. – were completely pre-specified and then compared in terms of gross crop receipts and net farm incomes.

Comparisons of alternative cropping programs were based on model runs for a 1000-acre farm in the Black soil zone in northeastern Saskatchewan. Inventories of land, machines, and buildings, and production methods typical of that region were assumed. Yields were calculated from equations in the model that relate yield to soil type, rotation, soil fertility status, fertilizer application rates, and other factors. Budgets were generated over historical input and product price series for several cropping programs involving various proportions of oats. All production methods and input application rates were pre-specified and consistent with current practices.

Production technology was assumed to be constant during the period examined. Relative crop yields calculated by the model were consistent with recent experience in the Black soil zone. The rotation used in the budget runs reflects the cropping pattern in the Black soil zone where fallow averages about 38 percent of the annual crop area, i.e., representing roughly a two-third crop rotation. Input prices with a 1979 base (1979 = 100) were indexed to maintain historical input and product price relationships over the budgeting period. Product-price series for the predominant grades of wheat, oats, barley, and rapeseed produced in the Black soil zone for the 1970-79 period were used. For wheat it was assumed that all of the output was delivered to the Canadian Wheat Board (CWB). CWB prices were therefore used.

For barley and oats, CWB and off-Board prices were weighted to reflect the proportions of prairie output that are delivered to the CWB or used for feed in the prairie area. The analysis assumed no inventory carry-over from one crop year to the next.

The crop model was used to budget several crop combinations for the 10-year period, 1970-79. The base situation (index =100) is a crop combination representative of recent experience in the Black soil zone, i.e., rapeseed – 22 percent, wheat – 58 percent, and barley – 20 percent. The Black soil zone is the area where oats are likely to be the most competitive. Other crop combinations budgeted reflect agronomic constraints, e.g., rapeseed is grown only on fallow; oats and rapeseed do not follow rapeseed. Gross crop receipts were averaged for five-year periods and for the entire 10-year period (Table 8). Notable in these comparisons is the relatively good performance of the cropping programs that include oilseeds and the poor performance of those with oats, especially in the latter five-year period.

Comparisons of net farm incomes for the crop combinations in Table 8 reveal more striking differences (Table 9). Net farm income calculated for the base situation was assigned an index of 100 to facilitate comparisons on a percentage basis among crop combinations. These comparisons reflect the similarities among cropping programs in production practices and costs. These combined with differences noted above in gross receipts result in large relative differences in net incomes. Net farm income with 100 percent oats was near zero for the 1975-79 period.

TABLE 8. GROSS CROP RECEIPT COMPARISONS FOR ALTERNATIVE CROPPING PROGRAMS

Crop	Percent of Crop Area	Indexes		
		1970-74	1975-79	1970-79
Rapeseed-Wheat-Barley	22-58-20	100	100	100
Wheat	100	93	100	97
Barley	100	95	83	87
Oats	100	74	65	69
Rapeseed-Wheat	50-50	108	109	108
Rapeseed-Barley	50-50	109	102	105
Wheat-Barley	50-50	94	92	93
Barley-Oats	50-50	87	76	80
Wheat-Oats	50-50	86	86	86

TABLE 9. NET FARM INCOME COMPARISONS FOR ALTERNATIVE CROPPING PROGRAMS

Crop	Percent of Crop Area	Indexes 1970-74	Indexes 1975-79	Indexes 1970-79
Rapeseed-Wheat-Barley	22-58-20	100	100	100
Wheat	100	98	99	98
Barley	100	92	50	69
Oats	100	37	2	18
Rapeseed-Wheat	50-50	115	122	119
Rapeseed-Barley	50-50	115	104	109
Wheat-Barley	50-50	88	80	83
Barley-Oats	50-50	70	34	51
Wheat-Oats	50-50	68	68	68

In the analysis of the competitiveness of oats in feedlot diets, oats were substituted for barley when the unit-weight price was 93 percent that of barley. That result was used in additional runs with the crop model to compare the same cropping programs as were used with the historical price series (Table 10). In this case only one-year budgets were calculated. With wheat, rapeseed, and barley priced at something approximating 1979 farm-level prices and oats priced at 93 percent of the barley price, the crop combinations with oats again did not fare as well as the others.

TABLE 10. COMPARISON OF CROPPING PROGRAMS AT 1979 PRICES EXCEPT OATS AT 93 PERCENT OF BARLEY PRICE

Crop	Percent of Crop Area	Indexes: Gross Crop Receipts	Indexes: Net Income
Rapeseed-Wheat-Barley	22-58-20	100	100
Wheat	100	103	112
Barley	100	88	60
Oats	100	76	25
Rapeseed-Barley	50-50	96	85
Rapeseed-Wheat	50-50	103	106
Wheat-Barley	50-50	96	90
Barley-Oats	50-50	83	52
Wheat-Oats	50-50	91	75

Other Factors Affecting Oat Production

In this section a few observations are made on technological and economic factors that may affect the competitive position of oats. They are based on limited discussions and data from researchers, processors, and farmers.

Oats as Insurance

The role of oats in the forage supply picture in which they are used as a dual-purpose crop was already mentioned. Perennial hay yields are highly variable, especially in the Brown and Dark Brown soil zones. Oats are therefore used to stabilize the forage supply. Another consideration is that oat harvesting occurs at a different time than that of perennial hay.

Oats are often recommended as a component in high-grain diets for feedlot cattle. An Agriculture Canada bulletin on feedlot finishing (Hironaka and Sonntag 1976) contains a recommendation to "include about 10 percent oats with the barley to help reduce digestive disturbances."[1] In other words, a minimum constraint based on biological considerations is often imposed to force some oats into diets. Recommended starter diets used to gradually introduce feedlot cattle to high-concentrate diets include about 25 percent oats. Oats play a similar role in some dairy and swine diets.

Weed Control

Wild oat herbicides (Avadex, Carbyne, Treflan, etc.) have probably contributed to the decrease of the oat crop in western Canada. Late-seeded oats were sometimes used as a wild oat control method in the past; now herbicides perform that function. (Wild oat herbicide usage in Saskatchewan doubled in the four years from 1975 to 1978 to a level of about 30 percent of the area seeded in 1978.) Wild oat herbicides cannot be used for oats.

Weed surveys coordinated by the Agriculture Canada Research Station at Regina indicate that more than half of the oat area in Saskatchewan was not treated with any herbicides in 1977. By comparison, only 15 percent of the wheat and 20 to 30 percent of the barley, rapeseed, and flax were not treated. This lack

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[1] Hironaka, R., and Sonntag, B.H., *Feedlot Finishing of Cattle* (Ottawa: Agriculture Canada 1976), p. 13.

of treatment probably reflects the use of oats as a feed crop rather than a cash crop on most farms. Broadleaf weed control was used on 82, 76, 46, 41, and 64 percent of the wheat, barley, oats, rapeseed and flax in 1977.

Other Crops

Oats were historically an important part of the crop mix in western Canada. Their decrease in the last 20 years coincides with the development of other cash crops (e.g., rapeseed, mustard, and peas) and the superior productivity obtainable from barley for feed use. On a weight basis, oat yields average about 90 percent of barley with similar inputs. (Table 1 shows that the oat decrease from about 1960 coincides with the growth in the rapeseed area.)

Hulless Oats

There has been some continuing interest in the development of hulless oats, especially for the food trade. Some hulless varieties have recently been licensed, e.g., Terra, but problems still persist.

So-called hulless oats are not completely hulless. There is apparently some hulled kernel production associated with current hulless varieties. When this factor is combined with the wild oat control problem there is in oats a potential for substantial contamination with hulled kernels.

Hulless oat production compares favorably with that of normal oats under good growing and harvesting conditions; groat yields of the best hulless varieties are approximately equal to those of the best hulled varieties. However, under adverse conditions hulless oats are difficult to handle. Furthermore, the present areas of concentration of oat production for grain coincide with the areas where harvesting difficulties occur frequently. Hulless oats are also more difficult to store than other cereals.

Processors have developed relatively efficient de-hulling techniques and markets for oat hulls. The de-hulling cost does not, therefore, appear to be an important consideration in producing food products from the two oat types. Furthermore, some processors indicate a preference for hulled oats for sanitary reasons.

The bulk of the oat crop is used as animal feed in which there is no demonstrated peculiar niche for hulless oats. The niche that oats do occupy in beef feedlot diets, for example, is partly due to their being hulled and having a lower energy concentration than other grains. With the present hulled varieties usually only a small proportion of the oat crop meets milling quality standards (Extra No. 1 Feed or better). This fact may suggest that if hulless oats were grown for the food market, a large proportion would likely be sold as feed grain because of their quality.

Oats as a Food Grain

Oats have been used principally as a feed crop. Some research and food industry personnel suggest that oats have good potential for expanded use as a food grain. Oats have many admirable qualities from a human nutrition perspective and recent and imminent technological advances in milling and other aspects of processing may improve the competitive position of oats relative to that of other food grains.

CONCLUSIONS

The decrease in oat production in western Canada is due to rational, economic decisions by farmers. Oat production has not been as profitable as other cropping alternatives. The change in relative profitability results from the introduction of new crops, greater productivity increases in other cereals, and changes in crop production technology.

Oats will continue to play a role as a feed crop, both as forage and as a small component of concentrate portions of animal diets.

If oats are to regain the competitive position they once had, substantial improvements in productivity relative to that of other cereals are needed. Given the feed energy value of oats relative to that of barley, i.e., 91 to 94 percent, yields of oats on a weight basis would need to be about 110 percent of barley yields for them to be competitive in feed grain markets.

The potential for oats as a food grain needs further assessment. Factors that need to be considered in such an examination include (1) the market demand for Canadian oat products, (2) the efficiency of new processing technology, (3) the production cost implications of growing milling quality oats, (4) the cost implications of providing the marketing mechanisms to enable expanded food use of oats (grades, transportation, storage, quotas, and contracts), and (5) the genetic potential of oats relative to valuable food components.

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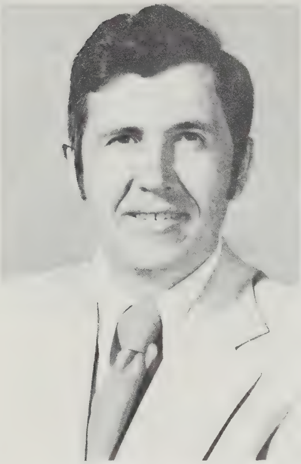
A MODEL FOR ESTIMATING SILO LOSSES AND COSTS



Storage losses, silo investment, and fixed and operating costs were estimated for 10 different combinations of silo type and preservative. The most economical silo type was found by comparing the value of the crop taken out of the silo minus storage costs for the various silo types.

*J. A. McIsaac and J. Lovering**

INTRODUCTION

Many types of silo can be used for storing silage. Each has different costs and storage losses associated with it. In this article a model is described which calculates the sizes and costs of silos needed to store given volumes of silage and which estimates the storage costs and losses associated with several types of silo. The trade-off between silo cost and storage loss for various silo types is shown and the most economical silos for various quantities and qualities of silage are identified. The silo model loss functions (Lessard 1975)** are based on experiments with timothy silage. The conclusions drawn for other crops such as corn, alfalfa, and annual ryegrass are only tentative.

SILO SIZE AND COST

A model which simulates a silo was constructed as part of a larger timothy-dairy model (Lovering and McIsaac 1980). The purposes of this silo model are to estimate the size of structure needed to store a given quantity of forage, considering the length of the feed-out period, and the minimum amount of silage that must be removed from the silage surface to prevent excessive losses from spoilage; to calculate the costs of storing the forage; and to estimate the quantity and value of dry matter and nutrient losses associated with the silo.

The silo types and treatments considered are as follows:

1. Tower silo
2. Tower silo with formic acid added
3. Horizontal silo with polyethylene covering
4. Horizontal silo with polyethylene covering and formic acid added
5. Horizontal silo with roof and polyethylene covering
6. Horizontal silo with roof, polyethylene covering, and formic acid added
7. Stack with polyethylene covering
8. Stack with polyethylene covering and formic acid added
9. Silo press
10. Upright oxygen limiting silo

Formic acid is added to the silage at a rate of 30 L/t of wet matter. The cost of formic acid used in the model is 91¢/L. The tower silos are of concrete stave construction. The tower silo costs cover total construction costs, including the foundation and the silo unloader. The blower and blower pipe for filling are not included.

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**J.R. Lessard to J.H. Lovering 1 May 1975: personal communication.

The horizontal silos are of tilt-up, concrete construction with a concrete floor and the silage is covered with polyethylene. A tractor with a front-end loader unloads the silos.

The stack silo is a stack of silage piled on a concrete pad and covered with polyethylene.

The silo press is a machine that presses the silage into polyethylene sacks. A full sack is 2.5 m in diameter and 25 m long.

The size of the tower silo is calculated from the average density of the silage in the silo and the weight of the silage to be stored. Halyk and Norris (1972) say that the dry matter density of silage in silos is 160-260 kg/m^3. For this model, information from the Canadian Code for Farm Buildings (1970) was used. The densities found in the Code were converted to dry matter densities and plotted (density versus depth of silage). An equation for dry matter densities in tower silos for any depth of silage was then derived:

average dry matter density (kg/m^3) = 145 + 6.713 x depth (m).

The average dry matter density of silage for horizontal silos used in the model is 177 kg/m^3.

To estimate the length of horizontal silo or height of tower silo needed, the length of the feeding period (measured in days) is multiplied by the minimum silage depth (cm/day) that must be fed from the silo each day. If the silo length or height exceeds the size restrictions imposed in the model, additional silos are used.

The restrictions on silo sizes are as follows:

Tower	Maximum height = 30 m
	Maximum diameter = the greater of half the height or 9 m
	Minimum diameter = height/4
	Minimum silage removed per day = 8 cm
Horizontal	Maximum length = 46 m
	Maximum total height = 3.5 m
	Maximum width = 18 m
	Minimum width = 6 m
	Minimum silage removed per day = 10 cm
Stack	Maximum length = 46 m
	Maximum silage height = 3.5 m
	Minimum silage height = 1.8 m
	Maximum width = 18 m
	Minimum silage removed per day = 10 cm

The model attempts to minimize the cost of horizontal silos by minimizing their perimeters. The length is established according to the length of the feeding period and the silo's feed-out rate. The maximum allowable width for the corresponding length is used as a starting point in calculating the size. The cross-sectional profile of the horizontal silo pile is determined according to the silo's width and height of the wall. The pile must be sloped to the sides to that water will run off the pile. The cross-sectional profile and pile height restrictions, as well as the length and width restrictions, must be met when determining the number and sizes of horizontal silos needed to store the crop.

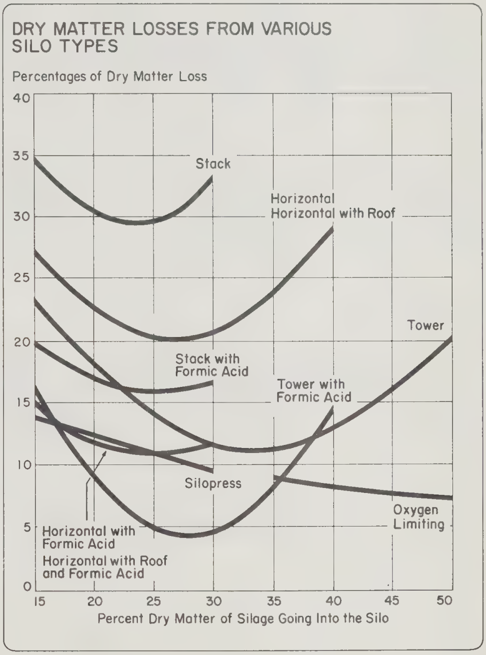

Figure 1

The cost of the horizontal silo is calculated from an estimate of the volume of concrete needed to construct the silo. The volumes of concrete needed are calculated by using a Canadian Farm Building Plans Service plan for tilt-up concrete horizontal silo construction. The cost of the silo includes all materials and labor required to complete the work.

The cost of tower silos is estimated with a formula derived from industry data on the new cost of various-sized silos: silo cost (\$) = $89.98V - .1404V^2 + 8.729 \times 10^{-5} V^2$, where V = volume of silage stored (m^3).

TABLE 1. A SAMPLE MODEL OUTPUT FOR A HORIZONTAL SILO

Height	Width	Length	Volume	Capacity	Average Silage Density	New Cost
1.3 m	12.5 m	37.2 m	$926.5/m^3$	163.3 tonnes	177 kg DM/m^3	$9 599

	In	Out	Loss
Dry matter (t)	163.29	129.54	33.75
Metabolizable energy (MJ/kg)	8.20	7.50	0.700
Crop value ($)	17 850	12 906	4 943

Percent crude protein in = 9.84
Percent digestible protein out = 5.61

ANNUAL COSTS

Depreciation	Repairs	Interest	Insurance	Taxes	Polyethylene Costs	Formic Acid Costs	Silo Unloading	Interest on Polyethylene & Formic Acid	Total
$480	$192	$384	$48	$72	$300	0.00	$200	$13	$1 689

	Per Year	Per Tonne Dry Matter In	Per Tonne Dry Matter Out
Storage cost	$1 689	$10.34	$13.03
Crop value out minus storage cost	$11 217	$68.70	$86.60

CROP LOSS

The model estimates the dry matter, protein, and metabolizable energy losses that occur in the various types of silo from the quantity and quality of the crop that is put into it.

Figure 1 illustrates the percentage of dry matter loss that can be expected for the various silos for a range of moisture contents.

For % DM $\leqslant$ 30

$\% DP_o = 0.926x\%CP_I - 3.5$
$ME_o = ME_I - 0.698$

For % DM > 30

$\% DP_o = 0.896x\%CP_I - 3.5$
$ME_o = ME_I - 0.461$

For % DM $\leqslant$ 30 and treated with formic acid

$\% DP_o = 0.929x\%CP_I - 3.5$
$ME_o = ME_I - 0.163$

For % DM > 30 and silo type 10

$\% DP_o = 0.931{*}xCP_I - 3.5$
$ME_o = ME_I - 0.163$

where: % DM = percentage of dry matter

$\% DP_o$ = percentage of digestible protein on a dry matter basis of silage coming out of the silo

$\%CP_I$ = percentage of crude protein on a dry matter basis of silage going into the silo

ME_o = metabolizable energy concentration (megajoules [MJ]/kg) on a dry matter basis on the silage coming out of the silo

ME_I = metabolizable energy concentration (MJ/kg) on a dry matter basis of the crop going into the silo

The loss functions for the tower, horizontal, and stack silos are based on work done by Lessard.* The functions that show the relationships between crude protein and digestible protein are based on work by Reid *et al.* (1959).

The loss functions for the silo press and the oxygen limiting silo are based on work by Zimmer (1971) and others.**

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*J.R. Lessard to J.H. Lovering 1 May 1975: personal communication.

**Mr. Kemp and Dr. Nicholson, Agriculture Canada Research Station, Fredericton, New Brunswick; Drs. Winter and Kunelius, Agriculture Canada Research Station, Charlottetown, Prince Edward Island: personal communication.

TABLE 2. TIMOTHY SILAGE STORAGE AND CROP LOSS COSTS AND DRY MATTER LOSSES FOR VARIOUS SILOS[a]

Silo Type	Silo Capital Cost	DM Lost	Storage Cost	Value of Crop Leaving the Silo	Crop Value Minus Storage Cost
	– $ –	– t –	– $ –	– $ –	– $ –
1. Tower	38 866	20.0	4 761	16 329	11 568
2. Tower with formic acid	38 866	7.3	6 245	18 935	12 690
3. Horizontal	9 599	33.7	1 688	14 767	13 078
4. Horizontal with formic acid	9 599	19.8	3 135	17 419	14 284
5. Horizontal with roof	23 105	33.7	3 343	14 767	11 424
6. Horizontal with roof and formic acid	23 105	19.8	4 817	17 419	12 602
7. Stack	5 388	53.6	1 157	12 498	11 341
8. Stack with formic acid	5 388	27.8	2 620	16 454	13 834
9. Silo press	14 000	15.5	4 738	16 788	12 050
10. Oxygen limiting[b]	64 754	6.9	7 932	18 977	11 045

[a]The material going into the silos is 30 percent DM, 9.46 MJ/kg ME, and 14 percent CP; 163 tonnes of DM are stored in each silo. The annual feeding period is 365 days.
[b]The material going into the oxygen limiting silo is 50 percent DM.

VALUE OF CROP LEAVING THE SILO

To compare silos, one must estimate the value of the crop as it is taken from the silo. The value of the crop leaving the silo minus the storage cost can be compared among silos to indicate the type of silo and treatment which is most economical for storing the crop being considered.

The silage value is estimated by calculating the total value of the energy and protein in the silage. The protein value is based on the value of protein supplements that would be needed to replace the protein in the silage. Similarly, the energy value is based on the energy value in energy supplements that would be needed to replace the energy in the silage.

The silo model is normally run as part of an overall crop-livestock model. The estimated value of the silage is not used as part of the crop-livestock model, but for the purposes of this paper and since the silo model can be used by itself, the value of the silage coming out of the silo is estimated to facilitate the comparison of various silos.

The equation for estimating the value of silage is as follows:

Silage value = (kg of total digestible nutrients – kg of protein)

x value per kg of non-protein digestible nutrients (\$.21/kg)

+ kg of protein x value per kg of protein (\$.13/kg)

The value of non-protein digestible nutrients and the protein value are based on values of those nutrients from energy and protein sources such as wheat, barley, soybean oil meal, and urea.

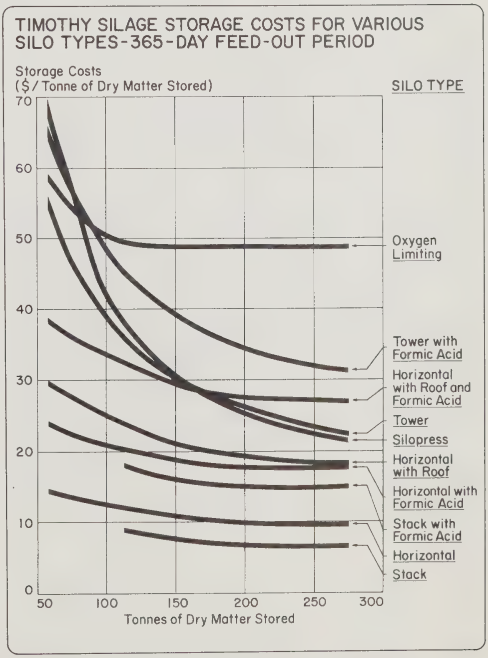

Figure 2

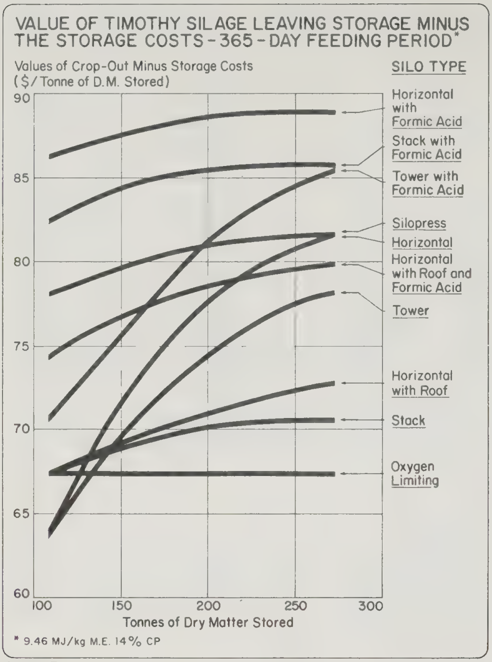

Figure 3

the quantity and quality of silage obtained, compared with the horizontal silo without formic acid.

The stack silo with formic acid added (silo type 8) and the horizontal silo (silo type 3) have values for "crop value minus storage cost" that are within 10 percent of the value for the horizontal silo with formic acid added.

Figure 2 illustrates the costs (dollars per tonne of dry matter stored) of storing various quantities of silage in 10 different silo types. The stack silo (silo type 7) is the cheepest of the silos for storing the quantities considered in this figure. The tilt-up concrete horizontal silo and the stack with formic acid added are the second and third cheapest silos. When considering the losses that can be expected from the various silos and the value of the crop leaving the silo, the most economical silo is the horizontal silo with formic acid added (silo type 4). This is shown in Figure 3 as well as in Table 2. The horizontal silo with formic acid added is the most economical for all the quantities from 100 t to 270 t. As the quantity of silage stored increases, the relative values of the tower silos (with and without formic acid added) and silo press increase because the costs of these silos, per unit of crop stored, decrease more rapidly with increasing volumes

RESULTS FROM THE MODEL

Table 1 shows a sample of the model's output, the number and sizes of silos needed, storage losses, and costs.

Silo costs, storage losses, and the value of the silage leaving the silo are shown in Table 2 for 10 silo types, and for a given quality and quantity of silage. The horizontal silo with formic acid added (silo type 4) has the highest value for "crop leaving the silo minus storage cost" when storing 163 tonnes (DM) of timothy at 30 percent DM, 9.46 MJ/kg of metabolizable energy (ME), and 14 percent crude protein. The only differences between silo type 3 (horizontal silo) and silo type 4 (horizontal silo with formic acid added) are the addition of the formic acid and higher repair costs due to the increase in corrosion caused by the formic acid. The annual costs of owning and operating the horizontal silo with formic acid added are $1447 more than the horizontal silo shown in Table 2, but the value of the silage, taken from the silo with formic acid added, is $2652 higher. This increase in the value of the silage leaving the horizontal silo with formic acid added more than pays for the additional costs involved to improve

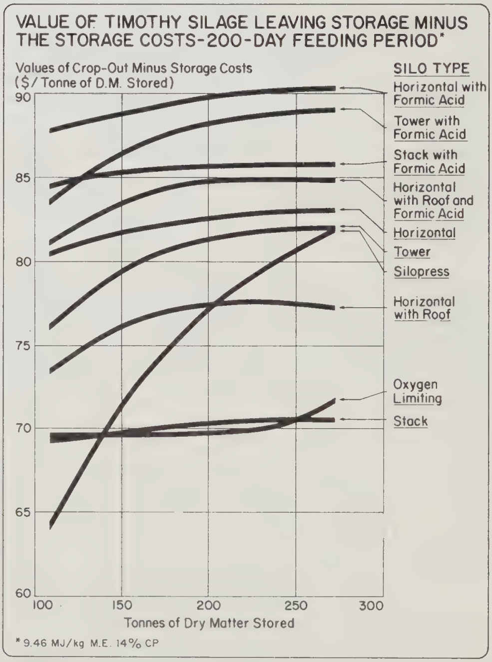

Figure 4

TABLE 3. VALUE OF CROP OUT MINUS STORAGE COST, 163 TONNES DM, 365-DAY FEEDING PERIOD

Silo Type	Corn 7.8% CP 10.80 MJ/kg ME	Alfalfa 20% CP 8.79 MJ/kg ME	Annual Ryegrass 18% CP 10.46 MJ/kg ME
1. Tower	16 006	9 593	13 134
2. Tower with formic acid	13 664	10 543	14 398
3. Horizontal	17 186	11 293	14 495
4. Horizontal with formic acid	16 782	12 308	15 855
5. Horizontal with roof	15 532	9 639	12 841
6. Horizontal with roof and formic acid	15 101	10 626	14 173
7. Stack	14 987	9 829	12 540
8. Stack with formic acid	14 439	11 968	15 318
9. Silo press	11 464	10 020	13 660

TABLE 4. VALUE OF CROP OUT MINUS STORAGE COST, 163 TONNES DM, 200-DAY FEEDING PERIOD

Silo Type	Corn 7.8% CP 10.80 MJ/kg ME	Alfalfa 20% CP 8.79 MJ/kg ME	Annual Ryegrass 18% CP 10.46 MJ/kg ME
1. Tower	17 494	11 082	14 623
2. Tower with formic acid	15 177	12 056	15 911
3. Horizontal	17 465	11 572	14 774
4. Horizontal with formic acid	17 063	12 589	16 136
5. Horizontal with roof	16 632	10 738	13 940
6. Horizontal with roof and formic acid	16 216	17 741	15 288
7. Stack	15 049	9 891	12 602
8. Stack with formic acid	14 501	12 030	15 380
9. Silo press	11 464	10 020	13 660

stored, then do the horizontal and stack silos. This is more evident when the length of the feeding period is 200 days a year as in Figure 4. With between 100 t and 150 t of dry matter stored, the tower silo with formic acid added (silo type 2) becomes more economical than the stack silo with formic acid added (silo type 8).

Tables 3 and 4 show the "value of crop out minus storage cost" for three different qualities or types of silage for 365- and 200-day feeding periods. The silage that is 7.8 percent CP and 10.8 MJ/kg ME represents corn silage, the 20 percent CP, 8.79 MJ/kg ME silage represents alfalfa, and the 18 percent CP, 10.46 MJ/kg ME silage represents annual ryegrass. The silos with formic acid added are generally more economical than the silos without formic acid for the silages with the lower energy concentrations. The addition of formic acid to the high energy silage corn is generally not economical.

Tables 3 and 4 show the value of the crop taken out of the silo minus the storage cost for nine types of silo and three types of silage. The volumes and qualities of silage fed and the value of the crop leaving the silo are identical for similar silo types in Tables 3 and 4. The only difference between the tables is that Table 3 represents a 365-day feeding period and Table 4 depicts a 200-day feeding period. The shape of the silo is different for the different lengths of the feeding period. For example, two tower silos are needed to store 160 t of dry matter when a 365-day feeding period is used. The requirement that 8 cm a day be fed from the silo dictates that the silo must be taller than the maximum height allowed. Therefore two silos are needed to meet the requirements. One silo can be used to store 160 t of dry matter if the length of the feeding period is 200 days. Similarly, for horizontal silos, the costs are higher for the 365-day feeding period than for the 200-day because a long, narrow silo is needed to meet the requirement of using at least 10 cm a day from the silage face. For the 200-day feeding period, a cheaper, wider, and shorter silo to store the same amount of silage is satisfactory.

LIMITATIONS

Two principal factors determine the usefulness of this model in assessing the merits of various silo types – the

accuracy of the equations describing losses of silage quality and quantity and the relevance of the method of assessing silage value. Depending on the class of stock to be fed and the quality of the silage, the method used to value the silage may overestimate the merits of silos that permit only small quality losses.

Losses in horizontal and stack silos are strongly influenced by the procedures used in filling the silo – particularly limiting the exposure of the silage to air. Good management in filling silos can strongly influence losses incurred in horizontal or stack silos. These losses may be much greater or somewhat less than those estimated by Lessard (1975).*

Labor requirements and costs for filling and feeding-out have not been considered. Depending on labor availability and on the nature of cattle feeding and housing facilities, the most appropriate silo may be other than that indicated by the model described.

It is generally clear, however, that the choice of silo type should be made in the context of the complete crop, harvest, cattle type, feeding, and housing facility system.

SUMMARY

The horizontal tilt-up concrete silo with a polyethylene covering and with formic acid added showed the largest "value of the crop out minus storage costs" in a group of 10 different combinations of silo type and preservative described in this article. The polyethylene covered stack and the horizontal tilt-up concrete silo with polyethylene covering have values of the measure of effectiveness within 10 percent of that for the horizontal tilt-up concrete silo with a polyethylene covering and with formic acid added.

The changing relative positions of the various silo type and preservative combinations with changes in quantity and quality of silage stored and with feed-out period were also shown.

Generally, the article demonstrated the importance of selecting a silo in the context of the whole crop, harvest, cattle type, feeding, and housing facility system.

*J.R. Lessard to J.H. Lovering 1 May 1975: personal communication.

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PROBLEMS IN ESTIMATING FARM PRODUCTION COSTS

Commodity production cost calculations are essential for resource allocation decisions and public policy formulations. This paper illustrates some problems and technical considerations respecting data representativeness and the theoretical assumptions, imputations, and joint cost allocations which are associated with calculating total production costs.

*M. Sorboe**

INTRODUCTION

Estimates of the costs of producing farm commodities are essential for good farm management and for establishing policies and programs which will contribute to the stability of real income and the growth of the agricultural industry. The Farm Credit Corporation and other lending agencies, for example, require production cost and return estimates for determining the amount of credit farmers can economically employ. The Agriculture Canada Stabilization Program provides for support prices based on production costs, and the provincial income assurance programs incorporate selected categories of costs in the formulas used for determining the amounts of compensation farmers will receive for shortfalls in net returns. Marketing boards and agencies regulate the prices farmers receive for certain commodities by basing them on costs of production.

In some programs, many of the problems and pitfalls associated with total cost calculations are avoided by incorporating only cash costs in their formulas and linking these with market prices. For example, the federal Western Grain Stabilization (WGSA) program is administered on a basis of the annual net cash flow which eliminates the need for subjective estimates of net returns to resources. But agencies such as the Farm Credit Corporation and the Prairie Farm Rehabilitation Administration (PFRA) require estimates of total costs and expected returns in administering their programs.

The purpose of this paper is to indicate and discuss some of the problems associated with calculating total costs and net returns to farm production factors. Some important technical considerations with respect to the representativeness of data, assumptions, and imputed costs are considered first. For illustrative purposes, these are followed by the presentation of a recent study of costs and returns to pasture in Saskatchewan.

Sources of Farm Production Cost Data

Frequently used approaches to production cost calculations are the area farm sample survey, the selected farm accounting service, and the farm budget method. The area farm sample survey usually involves a large number of farmers and the collection of data from farm records, memory recall, or both. A farm accounting service approach generally involves a smaller number of selected farm operators who maintain detailed records of actual receipts, expenses, and other data. The farm budget is a reconstruction of a typical production unit with updated or imputed prices and costs.

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Representativeness of Cost Data

The advantage of the area farm survey and the selected farm accounting service is that farm data are collected from actual producers. In this process the data may account for changes in farm size, farm practices, technology, farm organization, resource use, and other variable characteristics if the sample is stratified appropriately. The budget approach is cheap and saves time but may not be sufficiently reliable, with respect to representativeness, for important policy decisions.

In the farm survey and farm accounting service methods, representativeness will improve if the sample specification calls for a large, properly stratified, farm sample. If all of the appropriate statistical criteria are used in the farm selection process with respect to size, type, soil class, and so forth, it can be assumed that the probability of the sample data being representative of the average farm costs for the region will be high. Also, average costs could be calculated for farms of different type, size, soil class, and so on, as required.[1]

Assumptions and Imputed Costs

Problems arise in calculating production costs because many of the components are imputations which essentially derive from a choice of assumptions. In the cost categories itemized below only cash expenses are observable and many of these are often joint expenditures which must be allocated among two or more commodities. Costs of production can be broadly classified and considered in the following categories.

Cash Expenses

Seed, feed, fertilizer, spray material, oil and gas, taxes, and so forth, are included in this category. They are generally verifiable by invoices. Some cash expenses are used entirely in the production of one commodity and are therefore directly separable. Others are jointly used in producing two or more commodities and must be allocated. Some methods of allocating shares of joint expenses include: (1) farmer's estimates, (2) ratios of productive-man-work-units (PMWU), (3) crop acre ratios, and (4) ratios of incomes generated. Different proportions of expense shares will result in the use of alternative allocation methods.

Non-Cash Expenses

Unpaid family labor, operator labor and operator management, exchange labor, and farm-produced seed are examples of non-cash inputs which must be valued according to some criteria such as the value of hired labor, market value, or opportunity cost. Some farm situations may be different with respect to the opportunity cost of unpaid family labor; that is, there may be no alternative use for this labor on some farms. But to be consistent the analyst may choose to value such labor on all farms at the prevailing local wage rate.

Depreciation on Buildings and Machinery Inventories (Capital Cost Allowances)

Various depreciation rates on buildings, machinery, and equipment may be chosen which will give different capital cost results. If the rates are consistent with the building or machine life and the basis for valuation is the original cost, then the resulting cost calculation for the period will be a real cost estimate. However, when the prices of capital items are steadily increasing because of excess demand or inflation, the reserve for replacement, which is set aside on this basis, will be insufficient. For this reason, capital cost allowances (CCA) are often calculated on a basis of replacement value. Of course, this tends to overstate the original capital cost.

Also, as with cash expenses, the capital costs of buildings and machinery must be allocated among commodities. Here again assumptions are made in the choice of an allocation method and the resulting cost shares may differ substantially from one allocation method to another.

Interest on Capital Investment

This is probably the most controversial cost component and the most difficult to substantiate. Both the values of the capital items of land, buildings, machinery and equipment, and the interest rates used are manipulative. Capital items may be valued on the basis of original cost, replacement cost, or estimated market value. The interest rates may be based on the opportunity cost of the capital invested (bank, bond, or mortgage interest rates) or on the rates that the various lending institutions charge for farm loans.

RETURNS TO PASTURE STUDY

The author's recent study of the 1978 return to pasture in Saskatchewan was designed to contribute to an assessment of community pasture grazing fees. A select

[1] Average costs are considered here in the context of weighted averages, or mean values. Sample farm costs will be dispersed, generally quite widely, above and below the average.

TABLE 1. AVERAGE PRODUCTIVE-MAN-WORK-UNITS (PMWU) PER FARM

Livestock Enterprise	Number of Animals Per Animal Unit	PMWU Per Animal Per Year
Cows and bulls	1.0	1.50
Heifers, steers, and feeders	1.5	.83
Calves	3.0	.42
Hay, greenfeed, silage (2 cuts)	–	.90
Hay, greenfeed, silage (1 cut)	–	.60
Pasture	–	.15

part of the analysis should provide a good illustration of the problems encountered and the procedures taken in their solution.

Sample Design and Farm Selection

The data base for this study was developed from the WGSA CANFARM sample which included 720 grain and grain-beef cattle operations. Data for 1978 had been collected and processed before the pasture study was undertaken, so that the farms selected for this study constituted a sample within a larger probability sample of grain-beef cattle farms.[2] The beef cattle enterprises included in the pasture return study were selected according to an eligibility criteria so that the farms would conform with the PFRA pasture patron profile.

Saskatchewan farms in the WGSA CANFARM sample meeting the criteria included 42 in Region 4, 39 in Region 5, 40 in Region 6, and 55 in Region 7.[3] For comparative analysis the farms in each region were divided into two groups (high assessment and low assessment), based on the average number of assessment points for all farms in the region. Assessment points for each farm were calculated as the sum of the assessment value of owned land plus two-thirds of the assessment value of rented land. Farms with a higher than average assessment point rating have a low priority in community pasture allocation; farms with a lower than average assessment point rating receive a high priority.

The farms in each region were also subdivided into large and small farm groups, based on the average number of cattle animal units on the farms during the year. The coefficients for calculating animal units (AU) and PMWU were taken from the Alberta Agriculture's Farm Management Data Manual. The average per farm PMWU were calculated for the cattle enterprises to establish the value of labor for each farm group. A PMWU is the equivalent of an eight-hour day of adult labor.

Cash Expense Allocation

The WGSA CANFARM sample records selected for the study were of two enterprise accountings – that is, WGSA crops and beef cattle enterprises. Since the sample of farms was originally developed for determining the cash expenses associated with the production of WGSA designated crops, the difference between total farm cash expenses and WGSA cash expenses was attributed to the beef cattle enterprise and personal use. Adjustments were made to account for personal use portions of the following cash expenses:[4]

1. car operating expenses – two-thirds of total operating expenses minus the grain enterprise share
2. house repairs and maintenance – one-quarter of total house repairs minus the grain enterprise share
3. utilities – two-thirds of total utility expenses (telephone, electricity, and heating fuel) minus the grain enterprise share

Explanations for some items of cash (current) expenses follow.

1. Interest N-M – non-mortgage interest expenses – mainly interest expenses on current operating loans.
2. Other miscellaneous expenses – including negative expenses (for example, interest and patronage rebates, discounts received, and refunds).
3. Grain used – including grain purchased from other farmers or commercial firms as well as grain produced on the farm. Grain produced on the farm and used in the beef cattle enterprise was valued at prevailing market prices by the farmers.
4. Pasture service fees – to account for the value of breeding services received on community pastures this item was calculated at 28 percent of total pasture fees based on aggregate PFRA pasture revenues.

[2] A detailed description of the sampling procedure for the WGSA master sample is available on request.

[3] Region 4 – Southwest, Region 5 – South Central, Region 6 – North Central, and Region 7 – Southeast Saskatchewan.

[4] Farm management studies indicate that one-third of total car operating expenses and utility expenses are for personal use. One-quarter of house repairs and maintenance expenses are allowable farm business expenses for income tax purposes.

TABLE 2. CAPITAL COST ALLOWANCE (CCA) AND INTEREST ON INVESTMENT IN BUILDINGS AND MACHINERY,[a] PFRA CANFARM SAMPLE, 1978

CCA Rates	All Farms	High Assessment	Low Assessment
		dollars per animal unit	
High CCA rates			
CCA buildings and machinery	212	234	179
Interest on investment	67	74	56
Total	279	308	235
Low CCA rates			
CCA buildings and machinery	152	168	128
Interest on investment	103	115	87
Total	255	283	215
CANFARM CCA rates			
CCA buildings and machinery	195	220	158
Interest on investment	58	63	56
Total	253	283	214

[a]Interest rate of 9 percent based on 1978 Canada Savings Bond returns.

Inventory Changes

Changes in cattle, hay, and forage inventories were taken into account. Cattle inventory changes were accounted for by holding per head bull and cow (basic herd) values constant at the average 1978 values. Marketable cattle values were allowed to vary because insufficient data were available to differentiate between the effects of price and weight (quantity) increases on ending inventory values.

The basic per head herd values were kept constant so that cattle inventory changes would not be inflated by unrealized capital gains. Most of the marketable cattle would presumably be sold in the near future at or near the farmers' estimated values.

CCA and Investment

CCA and the average investment in buildings and machinery for each farm were recorded from three different calculations to determine the significance of the differences and to justify the choice of a particular method. Table 2 and Figure 1 show the results obtained from the following procedures:

1. CCA and return to investment in buildings and machinery based on indexed replacement costs for 1978, using the depreciating balance method and maximum allowable income tax rates for calculating CCA
2. CCA and return to investment in buildings and machinery based on indexed replacement costs for 1978, using the depreciating balance method and one-half the maximum allowable income tax rates for calculating the CCA
3. CCA and return to investment in buildings and machinery based on the original purchase price, using the allowable income tax rates of depreciation (as computed by CANFARM)

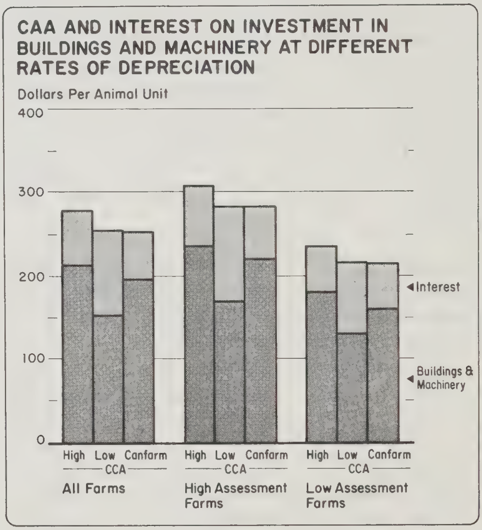

Figure 1

The tabulated results from the three methods show that separately, CCA and returns to investment were considerably different. However, the sums of CCA

and return to investment were not significantly different. In each case the return to investment was calculated at a rate of 9 percent of the average value of buildings and machinery for the year.

In this analysis, procedure 2, because it was the most acceptable to farm management specialists, was chosen for calculating the CCA and interest on building and machinery investment.

Farmers generally allocated one-quarter of the farm house value and two-thirds (66.7 percent) of the car value to the farm business. CCA and return to capital investments in buildings were allocated between WGSA crops and beef cattle enterprises on a basis of the ratios of allocated repair expenditures. The CCA and return to capital investments in machinery and equipment were allocated according to the ratios of allocated operating expenses (that is, cash expenses for fuel, licenses, repairs, and maintenance, and so forth). Cattle and hay inventory values were added to building and machinery inventory values for calculating interest on invested capital (excluding land) in the cattle enterprise.

Labor Valuation and Allocation

Labor requirements for the beef cattle enterprises were calculated in terms of the number of PMWU needed to handle the operations in 1978.[5] This procedure simplified the task of trying to allocate hired, operator, and family labor between WGSA crops and beef cattle enterprises. Each PMWU (equivalent to an eight-hour work day) was valued at $40.00, an average wage of $5.00 an hour for skilled and unskilled labor.

The labor value of $5.00 an hour was chosen after reviewing several reports relating to wages paid in 1978 and after several inquiries concerning the value of farm labor in Saskatchewan. If another rate had been chosen, $5.50 an hour for example ($44.00 per PMWU), the return to pasture per animal unit month (AUM) in Region 4 would have been $2.95 instead of the $4.98 calculated. This indicates the sensitivity of the residual return to a small change in the wage rate.

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[5] Alberta Agriculture, Farm Management Branch, *Farm Management Data Manual*, Publication No. 800-11.2.

Interest on Investment Capital

A rate of 9 percent was chosen for calculating the return to capital invested in hay land, buildings, machinery and equipment, livestock, and hay inventory. This rate approximated Canada Savings Bond yields in 1978 and, as a relatively safe investment alternative, it was considered an appropriate rate for calculating the opportunity cost of farm capital.

The sensitivity of capital costs (and residual returns) to interest rates can be shown by example. If a rate of 8 percent was chosen the return to pasture per AUM in Region 4 would be $6.91 instead of $4.98 as shown. If 10 percent was chosen the return would be $3.05 per AUM. It is obvious, therefore, that great care should be used in selecting an interest rate that reflects the real opportunity cost of invested capital.

Returns to Hay Land

If the value of an AUM of hay land was considered equivalent to an AUM of pasture the return to either of the land resources would be the same. For example, in Region 4 the return to hay land or pasture land on this basis was $3.94 per AUM.

Alternatively, a return to pasture was calculated as a residual. For this exercise the value of hay land per acre was established on a basis of productivity (hay yields), and the return to hay land (opportunity cost) was calculated at 9 percent of the investment in hay land. Improved hay land yielding 1.75 tons of hay an acre was worth $200 and the minimum value of hay land was $100 an acre. For example, land yielding one ton of hay an acre was valued at $\$100 + (\frac{1.0}{1.75} \times \$100) = \$157.10$ an acre. A relatively small amount of native hay land was valued at the minimum established value of $100 an acre. As shown in Table 3, this calculation produced a return to hay land of $3.19 per AUM in Region 4. Raising or lowering the benchmark value for hay land would have a significant effect on the return to hay and pasture land.

Returns to Pasture

The residual returns to pasture per AUM were calculated for each region by dividing the per farm return to pasture by the number of AU and then dividing that figure by the number of months of grazing. For example, the residual return to pasture per AUM in Region 4 was ($1386.03 ÷ 55.61) ÷ 5 = $4.98 (Table 3).

A five-month grazing period for private pasture was used to discount free grazing on stubble lands. Also, PFRA grazing periods are approximately five months in duration.

After all resource inputs had been accounted for at estimated market values the residual returns to pasture per AUM were calculated for each of the four regions. The average returns to pasture per AUM were $4.98 for Region 4, $6.24 for Region 5, $17.13 for Region 6, and $9.32 for Region 7, indicating considerably higher returns to pasture in the Parklands (Regions 6 and 7) than in the Brown and Dark Brown soil areas (Regions 4 and 5).

Reasons for the higher returns in the Parklands were not isolated. Plausible explanations include differences in the cow-calf-yearling combination of operations and the degree of winter feeding or finishing practices. Economies resulting from different practices such as these would be reflected in the residual returns to pasture.

TABLE 3. OPERATING STATEMENT AND RETURN TO PASTURE BY REGION, SASKATCHEWAN, 1978, BEEF CATTLE ENTERPRISE

	Farm Group			
Item	Region 4	Region 5	Region 6	Region 7
Number of farms	42	39	40	55
Size in animal units	55.61	64.87	68.06	50.07
Size in beef enterprise	141.19	178.62	153.96	128.5
	dollars per animal unit (AU)			
Cattle receipts[a]	228.70	209.20	241.72	217.53
Hay and forage sales	.98	2.34	1.28	1.59
Receipts from custom work	1.24	7.07	4.22	.61
Grants received (land tax rebate)	.58	.44	1.07	.56
Gas tax rebates	.09	.13	.23	.60
Miscellaneous receipts[b]	7.49	7.06	6.45	7.86
Total current receipts	239.08	226.24	254.96	228.75
Fertilizer expenses	1.25	.27	—	.25
Pesticide expenses	.05	.12	.01	.34
Tax expenses	1.46	.98	2.50	1.38
Car operating expenses (enterprise share)	2.53	1.94	1.41	2.21
Machinery operating	9.81	9.66	4.69	5.88
Machinery repairs and maintenance (R-M)	10.52	5.79	6.94	6.52
Custom work expenses	5.15	3.65	3.42	4.30
House R-M (enterprise share)	—	—	.03	—
Building R-M	2.49	1.50	3.44	3.70
Fence R-M	2.13	2.75	1.84	1.84
Tools and hardware	2.48	2.53	2.47	2.80
Office supplies	.53	.44	.39	1.27
Utilities (enterprise share)	8.16	5.60	5.85	3.92
Insurance expenses	2.55	1.22	1.70	1.72
Interest N-M (non-mortgage)	.74	.01	4.08	.16
Commercial feed purchase	14.46	19.33	16.40	12.04
Livestock supplies and service	6.40	5.12	2.51	4.70
Marketing expenses	.20	1.59	.27	1.71
Rent expenses (excluding land)	.21	.24	.01	.18
Stabilization insurance	—	—	—	—
Water S-S (supplies and service)	.08	.08	.67	.14
Other miscellaneous expenses	.16	.04	−.14	−.21
Grain used (value)	4.08	.98	5.40	.47
Hay purchases	4.66	2.12	3.08	1.10
Pasture service fees	.27	—	.54	.27
Total current expenses	80.39	65.95	67.43	56.68

— continued —

TABLE 3. OPERATING STATEMENT AND RETURN TO PASTURE BY REGION, SASKATCHEWAN, 1978, BEEF CATTLE ENTERPRISE (concluded)

	Farm Group			
Item	Region 4	Region 5	Region 6	Region 7
		$/AU		
= Excess of current income over current expense	158.69	160.29	187.53	172.07
± Change in inventory				
Cattle[c]	80.38	99.88	100.04	+86.88
Hay and forage	−2.53	1.74	−12.29	+.89
= Return to capital and labor (before CCA)	236.54	261.91	275.28	259.84
− CCA for 1978				
Buildings	3.26	2.56	5.41	6.53
Machinery and equipment	19.99	19.82	14.56	14.56
= Return to capital and labor	213.29	239.53	255.31	238.75
− Return to labor[d]	101.56	110.14	90.48	101.38
− Return to investment in buildings, machinery, cattle, and hay[e]	64.48	68.33	59.85	65.19
= Return to hay and pasture land	47.25	61.06	104.98	72.18
Return per animal unit month (AUM)	3.94	5.09	8.75	6.02
− Return to hay land per AUM	3.19	3.67	2.76	3.66
= Return to pasture per AUM	4.98	6.24	17.13	9.32

[a]Sales minus cattle purchases.
[b]Includes income from building and machinery rentals.
[c]With basic herd (bulls and cows) values per head constant.
[d]Calculated at $5.00 an hour ($40.00 per eight-hour day or PMWU).
[e]Calculated on a basis of an opportunity cost of 9 percent (that is, approximating the 1978 Canada Savings Bond interest yield).

Source: WGSA CANFARM Sample, 1978.

A summary of returns to pasture per AUM (Table 4) shows that the returns on high and low assessment farms were not consistent between regions. In Regions 4 and 5 the returns were higher on low assessment farms, whereas in Regions 6 and 7 they were higher on high assessment farms. The returns on large and small enterprise farms were considerably different from region to region.

Weights were established for each region based on recent PFRA pasture allotments. These weights were multiplied by their respective regional returns to pasture to obtain average returns per AUM for Saskatchewan – $9.24 for all farms, $9.42 for high assessment farms, and $9.55 for low assessment farms. Comparable returns for large cattle enterprises were $11.44 per AUM and for small cattle enterprises $3.14 per AUM. It should be recognized, however, that the size of the cattle enterprise counterpart was not necessarily dependent on, or associated with, the total farm size.

SUMMARY AND CONCLUSIONS

This paper documented some problems associated with commodity cost calculations. A recent study of returns to private pasture in Saskatchewan was used to illustrate some of the theoretical and technical considerations encountered in cost imputations and joint cost allocations.

Two main sources of data were discussed – the farm sample method and the budget method. Preference for the farm sample method of obtaining data was expressed for reasons associated with data representativeness. The disadvantages of the sampling approach are the time and cost factors. Fortunately, for the returns to pasture study, a relatively large CANFARM probability sample of grain-beef cattle farms had been surveyed for the WGSP and an adequate representation of grain-beef cattle enterprise farms was available as a subsample.

TABLE 4. SUMMARY OF AVERAGE RETURNS TO PASTURE, ALL REGIONS AND FOR SASKATCHEWAN[a]

Area	All Farms	High Assessment	Low Assessment	Large Cattle Enterprise	Small Cattle Enterprise
			dollars per animal unit		
Region 4	4.98	1.63	12.58	14.31	−24.85
Region 5	6.24	2.49	10.59	5.66	13.15
Region 6	17.13	20.31	12.90	13.17	25.30
Region 7	9.32	14.22	2.37	12.47	2.20
All Saskatchewan[b]	9.24	9.42	9.55	11.44	3.14

[a]With breeding herd (bulls and cows) values per head remaining constant during the year.
[b]Weighted according to PFRA pasture allotments (that is, in terms of the number of cattle for each region) in recent years. Weight ratios: Region 4 — .265; Region 5 — .246; Region 6 — .234; and Region 7 — .255.

The analytical methodology followed in the returns to pasture study incorporated the following technical considerations and assumptions.

1. Return to pasture is the residual return, or what is left after all other resource inputs have been charged at current (1978) market values.
2. Beef enterprise cash expenses are the producer's allocations based on differences between total farm cash expenses and allocated WGSA crop cash expenses.
3. Beef cattle inventory change is the difference in beginning and ending year values of cattle, based on maintaining a constant value per head for the breeding herd (cows and bulls), and allowing for the existing market value per head for all other classes of cattle.
4. Beef cattle enterprise capital cost on buildings is the ratio of allocated building repair expenses times the total farm CCA on buildings.
5. Beef cattle enterprise capital cost on machinery and equipment is the ratio of allocated operating and maintenance expenses times the total farm CCA on machinery and equipment.
6. Return to investment in buildings, machinery, cattle, hay, and hay land is 9 percent, based on the 1978 Canada Savings Bond yield.
7. Hay land value is $200 an acre for hay land yielding 1.75 tons of hay an acre (minimum value of $100 an acre for improved and native hay land).
8. Return to labor is $5.00 an hour or $40.00 a day based on an eight-hour day (one eight-hour day equals one PMWU).
9. The pasture season lasts five months, net of free grazing on stubble lands.

Analysis of the farm sample gave a range of returns from $4.98 per AUM in Region 4 to $17.13 per AUM in Region 6, with a Saskatchewan weighted average of $9.24 per AUM. This means that, based on the analysis, the average producer had a residual return to pasture land of $9.24 for each AUM of pasture supplied on his farm for 1978.

It is clear that any change in the assumptions with respect to imputed costs could have a significant effect on the calculated costs and residual returns. For example, if labor was valued at $5.50 instead of $5.00 an hour the return to pasture per AUM in Region 4 would be $2.95 instead of $4.98 as shown. If the rate of return to farm capital (opportunity cost) was 8 percent instead of 9 percent, the residual return to pasture per AUM in Region 4 would be $6.91. If 10 percent had been chosen the pasture return would be $3.05 per AUM instead of $4.98 as calculated.

Production cost and return calculations are often viewed as objective and absolute figures. For the reasons indicated in this paper they should be critically considered as estimates of the real costs and returns. Their representativeness and reliability should be assessed in terms of the data source, the theoretical assumptions, and the imputations that are necessarily a part of the analysis.

Finally, there may not be any individual farmer whose production costs are equal to the derived average costs. Most, and perhaps all, sample farmers will be dispersed above or below the average.

ECONOMIC INDICATORS

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978			1979					1980	
		III	IV	Annual	I	II	III	IV	Annual	I	II
Production and Income											
1. GNP at Market Prices[a]	$ mil.	233,200[b]	237,968[b]	229,698[b]	247,496[b]	256,256[b]	264,712[b]	272,756[b]	260,305[b]	278,700[b]	281,384
2. Farm Cash Receipts Total[d]	$ mil.	2,900.3[b]	3,341.6[b]	11,899.0[b]	3,380.5[b]	3,255.0[b]	3,430.1[b]	3,904.8[b]	13,970.9[b]	3,799.5	3,451.9
3. – Total Crops[d]	$ mil.	1,161.0[b]	1,248.0[b]	4,906.1[b]	1,447.3[b]	1,188.3[b]	1,464.8[b]	1,764.5[b]	5,861.3[b]	1,829.4	1,349.1
4. – Total Livestock[d]	$ mil.	1,645.3[b]	1,923.7[b]	6,541.5[b]	1,861.1[b]	1,938.9[b]	1,872.3[b]	2,051.9[b]	7,724.1[b]	1,903.5	1,975.5
5. Net Income Rec'd by Farm Operators[a]	$ mil.	3,076.0[b]	3,240.0[b]	3,214.0[b]	3,988.0[b]	4,348.0[b]	3,280.0[b]	4,152.0[b]	3,942.0[b]	3,380.0[b]	2,648.0
Trade											
6. Agricultural Exports	$ mil.	1,261.3[b]	1,391.8[b]	4,846.3	1,204.4	1,354.7	1,663.9	1,884.8	6,107.8	1,501.5	2,008.2
7. Agricultural Imports	$ mil.	943.2	1,104.4	4,015.06	1,129.2	1,181.6	1,129.4	1,240.4	4,680.6	1,158.9	1,256.9
8. Real Domestic Product, Ag[a]	1971=100	117.5[b]	119.7[b]	117.8[b]	109.7[b]	104.9[b]	105.5[b]	112.4[b]	108.1[b]	111.5[b]	112.9
9. Real Dom. Prod. Less Ag[a]	1971=100	136.6[b]	138.3[b]	135.9[b]	138.3[b]	138.9[b]	140.8[b]	140.4[b]	139.6[b]	140.1[b]	138.8
Price Indexes											
10. Farm Input Price Index	1971=100	203.2	209.2	201.1[b]	229.0[b]	233.9[b]	235.6[b]	239.1[b]	234.4[b]	253.7	251.3
11. – Buildings and Fencing	1971=100	203.1	209.9	201.0	216.1	233.2	229.5	235.3	226.0	235.5	235.5
12. – Machinery & Motor Veh.	1971=100	176.0	182.1	176.2[b]	188.0	191.8[b]	196.2[b]	205.3	193.3	214.2	220.9
13. – Crop Production	1971=100	228.3	230.2	225.5	238.6	252.5[b]	258.5[b]	266.5	254.0	296.9	308.8
14. – Animal Production	1971=100	207.3	218.2	201.8	246.8	252.3[b]	249.2[b]	247.8	249.0	252.7	232.8
15. – Hired Farm Labor	1971=100	223.9	225.4	220.4	228.0	232.8	235.7	237.8	233.6	242.1	245.1
16. – Interest	1971=100	284.5	284.5	284.5	385.1[b]	385.1[b]	385.1[b]	385.1[b]	385.1[b]	474.7	481.6
17. Farm Prices of Ag. Prod.[d]	1971=100	209.9	221.9	217.6[b]	250.3[b]	250.7	247.7[f]	246.4[f]	298.8[f]	248.7[f]	242.5
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	418.8	342.4	1,288.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	479.3	490.3	473.0	499.7[b]	497.7[b]	466.7[b]	475.3	484.9	498.0[b]	481.0
20. Av. Farm Labor Rates	$/hr.	3.78	3.84	3.76	3.89	3.95	4.01	4.08	3.98	4.15	4.22
21. Av. Hourly Earnings-Manf.	$/hr.	6.87	7.03	6.84[b]	7.19[b]	7.37[b]	7.50	7.68	7.44	7.90	8.05
22. F.C.C. – Gross Loan Disburs.	$ mil.	205.7	121.7	533.6	35.4	174.7	192.4	145.2	547.7	98.5	189.6
23. CPI – All Items	1971=100	177.7	180.5	175.2	184.6	189.4	193.1	197.6	191.2	202.0	207.6
24. – Food at Home	1971=100	218.7	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0	250.3	258.2
25. – Food Away from Home	1971=100	202.2	207.3	199.3	213.1	220.8	227.3	232.4	223.4	237.1	240.7
26. Industry Selling Price Index – Food & Beverage	1971=100	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.3[b]	237.5[b]	231.7	244.0[b]	247.8

continued

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1978			1979					1980	
		III	IV	Annual	I	II	III	IV	Annual	I	II
Other Indicators											
27. Unemployment Rate	%	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1	7.3	7.5	7.4	7.6
28. Exchange Rate	$ U.S.	1.14	1.18	1.14	1.19	1.16	1.17	1.19	1.17	1.16	1.17
29. Av. Rate on New Demand Loans	%	10.03[b]	12.32	10.18	12.31	12.55	12.81	15.27	13.24	15.33	16.30
30. Quarterly Pop. Est.	mil.	23.50	23.55	23.48	23.60	23.65	23.69	23.74	23.67	23.81	23.87

[a]Seasonally adjusted at annual rates.
[b]Revised.
[c]Preliminary
[d]Excludes Newfoundland.
[e]Excluding repair parts.
[f]Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Marketing and Economics Branch; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

NOTES

CORN FORMULA PRICING MECHANISM: HOW IT WORKS

This note was prepared for Canadian Farm Economics by J.A. Gellner of Agriculture Canada's Commodity Markets Analysis Division, Marketing and Economics Branch.

Introduction

The corn formula pricing mechanism came into effect in August 1976 as a result of modifications to the domestic feed grain policy. Under the formula, feed grains sold in the domestic market by the Canadian Wheat Board (CWB) are priced in relation to the cost of U.S. corn. The formula pricing mechanism is intended to ensure that domestic feed grains remain competitive with U.S. corn, which is the major feed alternative for the domestic livestock industry as well as the most important measure of international feed grain prices. The formula for calculating the corn-competitive price was developed and is administered jointly by the CWB and the Canadian Livestock Feed Board.

To help describe the formula, the calculation procedure is dealt with in three sections:

1. price calculation of U.S. corn landed at Montreal
2. application of the energy-protein adjustment to derive corn-competitive prices at Montreal
3. adjustment of the Montreal corn-competitive price to prices in-store at Thunder Bay and prices at local prairie positions

U.S. Corn Landed at Montreal

The corn formula price is calculated daily. A sample calculation is given in the accompanying table. (It does not necessarily reflect actual data for a given period.)

The first step is to calculate the price of U.S. corn landed at Montreal. The process begins with the previous day's closing futures price for Number 2 Yellow corn from Chicago Board of Trade quotations for the nearby futures month and the corresponding cash price at the port of Toledo for corn loaded aboard a lake vessel. In the example, the closing Chicago futures price for corn is U.S. \$2.70/bu and the Toledo cash price is U.S. \$2.80/bu.

The Toledo cash price is converted to Canadian dollars and adjusted for the corn tariff and for Toledo-to-Montreal movement costs based on water rates. The calculation yields the price of U.S. corn landed at Montreal in Canadian dollars per bushel, which in the example is \$3.68/bu or \$.98 over the Chicago futures price. During the weeks of closed navigation, the Chicago March futures price is taken as the cash price and adjusted to Montreal using water rates. The current day's corn price is calculated by obtaining the morning opening quotation (9:55 a.m. central) for the Chicago nearby futures and adding the difference between the Montreal price and the Chicago price calculated from the previous day. In the example, the opening price is U.S. \$2.72/bu, which with the difference of \$.98/bu, yields the current day's corn price landed in Montreal of \$3.70/bu or \$145.70/t.

Energy-Protein Adjustment

The energy and protein content of different feed grains varies and the value of the energy and protein differs with the class of livestock being fed. For example, wheat, barley, and oats contain more protein and less energy than corn. When wheat, barley, or oats are substituted for corn, smaller amounts of supplemental protein (usually soybean meal) are required to obtain a proper energy-protein balance in a feed ration. If the price of protein increases relative to the price of energy, wheat, barley, and oats become more valuable relative to corn because of their higher protein contents. The feeding values of wheat, barley, and oats, relative to that of corn were calculated in the formula to reflect these differences.

Benchmark feeding values for these grains were determined by calculating the "prices" of energy and protein from corn and soybean meal based on an "equilibrium" soybean meal-corn ration of 1.8 to 1.

The energy and protein "prices" were calculated using a simple set of simultaneous equations as follows:

1. $a_1 x + b_1 Y = Pc$
2. $a_2 x + b_2 Y = Ps$

where a_1 and a_2 are the energy ratings for corn and soybean meal, b_1 and b_2 are the protein ratings for corn and soybean meal,

X is the value of energy,
Y is the value of protein,
Pc is the price of corn, and
Ps is the price of 49% soybean meal.

CORN FORMULA PRICING MECHANISM

Procedure	$/bu	$/t
1. U.S. corn landed at Montreal[a]		
(a) Nearby futures price – Chicago corn (previous day's close)	U.S. 2.70	106.3
(b) Toledo cash price f.o.b. lake vessel	U.S. 2.80	110.2
(c) Convert to Canadian dollar (U.S. $1 = Can. $1.18)	3.30	130.0
(d) Add movement costs, Toledo to Montreal, and corn tariff (7.6¢/bu)	.38	15.0
(e) Landed price of U.S. corn, Montreal, Can. $ (from previous day's close)	3.68	145.0
(f) Difference between Montreal price and Chicago nearby futures ($3.68 – $2.70)	.98	38.6
(g) Nearby futures prices – Chicago corn (current day opening quotation, 9:55 a.m. central)	2.72	107.1
(h) Landed price of U.S. corn, Montreal ($2.72 + $.98, from current day's open)	3.70	145.7
2. Energy protein adjustment		
(a) Landed price of U.S. soybean meal at Montreal Ps (Can. $ per ton)	–	250
(b) Landed price of U.S. corn at Montreal, Pc (Can. $ per ton)	–	131.4
(c) Price ratio of soymeal to corn, equal weight basis (Ps/Pc)	–	1.9:1
(d) Calculation of corn-competitive price for 1 Fd. barley (Pb) at Montreal:		
Vb = 81.1 + 6.3 (Ps/Pc), with Vb the price ratio of barley to corn		
Vb = 81.1 + 6.3 (1.9)		
Vb = 93.1		
Pb = (931/100) x Pc = .931 x 145.7 = 135.6	–	135.6
(e) Calculation of corn competitive price for 3CU wheat (Pw) at Montreal:		
Vw = 84 +10 (Ps/Pc), with Vw the price ratio of wheat to corn		
Vw = 84 + 10 (1.9)		
Vw = 103.0		
Pw = (103/100) x Pc = 1.03 x 145.7 = 150.1	–	150.1
(f) Calculation of corn competitive price for 1 Fd oats (Po) at Montreal:		
Vo = 76.1 + 6.3 (Ps/Pc), with Vo the price ratio of oats to corn		
Vo = 76.1 + 6.3 (1.9)		
Vo = 88.1		
Po = (881/100) x Pc = .881 x 145.7 = 128.4	–	128.4
3. Calculation of corn-competitive prices, quoted daily at 10:00 a.m. central in-store at Thunder Bay (deduct movement costs, Thunder Bay to Montreal):		
(a) Barley, 1 Fd (135.6 – 19.4)	–	116.2
(b) Wheat, 3 Cu (150.1 – 16.4)	–	133.7
(c) Oats, 1 Fd (128.4 – 25.8)	–	102.6

[a]The prices and costs do not necessarily reflect actual data for any specific period.

These equations were solved for X and Y and these values applied to the energy and protein ratings for wheat, barley, and oats to determine the corresponding values of these grains which were expressed as a percentage of corn. For example:

$$3.\ a_3 X + Y b_3 = P_b$$

where P_b is the value of barley, a_3 and b_3 are the energy and protein ratings for barley, and X and Y are the energy and protein values calculated from equations 1 and 2.

The energy and protein ratings for wheat, barley, and oats were established according to their principal use in eastern Canada. Thus, in the formula the energy and protein ratings for wheat were based on poultry feeding, for barley on hog feeding, and for oats on dairy feeding. The benchmark values are as follows:

Barley (hog feeding)	92.5% of corn
Wheat (poultry feeding)	102.0% of corn
Oats (dairy feeding)	87.5% of corn

The benchmark values hold as long as the price ratio of soybean meal and corn at Montreal is 1.8 to 1. As this ratio changes the relative values of the grains also change.

If the soymeal-corn ration is allowed to vary, given the same energy and protein ratings, a new set of barley,

wheat, and oat values relative to that of corn is generated. Given the whole set of soybean meal-corn price ratios, within the range of 1.5 to 3, a corresponding set of barley, wheat, and oat values, expressed as a percentage of corn, can be generated. The soybean meal-corn price ratios can then be related to the feed grain-corn price ratios in the form of a simple linear regression equation to arrive at the energy-protein adjustment equations as follows:

4. Barley: $Vb = 81.1 + 6.3\,(Ps/Pc)$

5. Wheat: $Vw = 84 + 10\,(Ps/Pc)$

6. Oats: $Vo = 76.1 + 6.3\,(Ps/Pc)$

where Vb, Vw, and Vo are the values of barley, wheat, and oats expressed as percentages of the corn value,

Ps is the price of 49% soybean meal, and
Pc is the price of corn.

In the example, the soybean meal-corn price ratio is 1.9 to 1, which using equation 4, gives the value of barley relative to that of corn as 93.1 percent. The landed price of U.S. corn at Montreal is $145.70/t and the resulting corn-competitive price of barley at Montreal is $135.60/t ($145.7 x .931 = $135.60).

Adjustment to Thunder Bay and Prairie Points

The process of calculating Thunder Bay prices from the corn-competitive prices at Montreal consists of deducting movement costs between Thunder Bay and Montreal. These costs are calculated and updated as necessary by the CWB and include freight (at water rates), insurance, lockage, seaway tolls, f.o.b. charges, and brokerage. The CWB quotes the resulting prices daily (10:00 a.m. central) as their domestic selling prices for feed grains. In the example, the Thunder Bay corn-competitive price of barley is $116.20/t ($135.60 - $19.40 = $116.20).

The Thunder Bay price is backed off to prairie positions using the Statutory Crow Freight Rates. The CWB makes domestic feed grain offerings at these Crow adjusted prices to its agents at local prairie points. The actual purchase price to the local user is agreed upon by the agent and the local user.

IN REPLY

We appreciate your letters and comments on articles in Canadian Farm Economics. Let us know if you think a subject deserves an article and we shall try to accommodate you.

When forwarding your "In Reply," or letter, please indicate if we may publish your comments in a subsequent issue.

Our anniversary issue of April 1980 was immensely popular with our readers. L.E. Philpotts, a consultant, of 7 Phillip Drive, Ottawa, Ontario, K2E 6R6 said that it was "a very informative issue regarding the history of agricultural economics in the federal concept. Well done!"

Dr. L. Lloyd G. Reeds, Professor of Geography, McMaster University, Hamilton, Ontario, L8S 4K1 said that "the articles provided interesting background on development of agricultural economics and effects on policy during the last 50 years." He also said that in his field of agricultural geography it is important to keep abreast of developments in agricultural economics. Dr. Reeds would like to have seen some further elaboration of types of research problems being studied.

David E. Ward, District Agriculturist, 2001 Sherwood Drive, Sherwood Park, Alberta, T8A 3J4 "appreciated the article detailing the history of the Economics Branch in the April issue of CFE. As a student in the mid-50's, a tremendous amount of information for student 'papers' came from the *Economic Annalist* and as an early worker in farm management in P.E.I., much assistance, advice, and information came from various staff members of the Economics Branch. Over the years, I had the opportunity to meet many of the staff whose names appear in the CFE article. Thanks for the memories!"

Mr. J.E. McLachlin, a teacher from Oxford Station, Ontario, K0G 1T0 thought that Fred O'Riordan's explanation of benefit-cost analysis in our June 1980 issue was excellent. In fact, he said that the whole issue was very useful to him.

IN REPLY TO AUTHORS AND EDITORS REGARDING OCTOBER 1980 *CANADIAN FARM ECONOMICS*

I have read one or more of the following articles:

(1) The Economics of Oat Production in the Prairie Provinces
(2) A Model for Estimating Silo Losses and Costs
(3) Problems in Estimating Farm Production Costs

1. My comments are on article number (1) (2) (3).
2. On a scale of one to ten how useful was this article to you?

not useful ____________________________________ very useful

1 2 3 4 5 6 7 8 9 10

3. Why?

4. How useful was the whole issue to you?

5. Do you have any suggestions or questions on the contents of this issue?

My comments may ( ) may not ( ) be used in a future issue of this publication. (A copy of your comments will be forwarded to the author.)

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Please return the above to:

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Canada
K1A 0C5

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

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Agriculture Canada

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CANADIAN DAIRY POLICY – THE SEVENTIES

V. McCormick*

Canadian dairy policy has been instrumental in keeping industrial milk deliveries well in balance with market requirements on a butterfat basis. This policy has created a stable environment for producers, particularly since the introduction of the Returns Adjustment Formula. Although the basic goals of dairy policy appear to have been achieved, the net costs of the policy have been high.

INTRODUCTION

Canadian dairy policy in the 1970s retained many of the elements initiated in the 1960s,[1] but there were modifications and refinements to the price support system. The federal government continued to support butter and skim milk powder, resulting in an effective support for industrial milk and cream. Policy changes during the decade included the introduction of the Market Sharing Quota (MSQ) and the "sleeve" or tolerance in relation to the quota, the Returns Adjustment Formula to determine the target price for industrial milk, the Butterfat Exchange Program, changes in the levy structure, and the change in the dairy year from April 1 to August 1, beginning in 1979. In the trade sector, the United Kingdom's entry into the European Economic Community (EEC) had an adverse effect on Canada's cheddar cheese exports. Canada established a quota on cheese imports (mostly variety cheeses) in 1975. Previous to this, cheese had been included on the Import Control List, but permits had been issued freely for natural cheese (other than cheddar and colby) for direct consumption. A discussion of these changes is the theme of this paper.

More specifically, this paper updates the previous article "Dairy Price Support in Canada – 1962-72," in the October 1972 issue of *Canadian Farm Economics.* The present review of federal dairy policy focuses on the following points: milk production levels, marketing quotas, dairy supports (including the milk pricing formula), producer levies, cheese trade barriers, and dairy import and export programs. The paper deals with federal dairy policy only. As the marketing of fluid milk for fresh consumption is under the jurisdiction of the provinces, and does not normally cross inter-provincial borders, provincial fluid quotas are not discussed.

MILK PRODUCTION IN THE 1970S

Farm sales are an indication of producers' responses to policy and market conditions. Farm sales of milk and cream, in milk equivalent, declined about 6 percent from 1970 to 1975, reflecting several factors – including adverse weather in regions of Eastern Canada and alternative opportunities for dairy farmers. To compensate for the shortfall in milk production, it was necessary to import 63 million kilograms of butter in the 1971-72 to 1974-75 (dairy year) period to meet domestic requirements.

Milk production began to increase in May 1975 in response to higher support and market prices for milk and dairy products, provincial incentive programs to encourage industrial milk production, favorable crop and climatic conditions, heavier feeding of concentrates, lower beef prices, and fewer alternatives for dairy farmers. In the 1975-76 dairy year, industrial milk and

*V. McCormick is an economist with the Commodity Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada, Ottawa.

[1] V. McCormick, "Dairy Price Support in Canada, 1962-1972," *Canadian Farm Economics* 7 (October 1972): 2-7.

TABLE 1. FARM SALES OF MILK IN CANADA,[a] 1975-80

Calendar Year	Fluid Purposes	Industrial Milk	Industrial Cream[b]	Total Industrial Use	Total Farm Sales
			million litres		
1975	2277.8	4357.0	405.5	4762.5	7040.3
1976	2332.3	4153.6	346.5	4500.1	6832.4
1977	2383.4	4276.0	322.2	4598.2	6981.6
1978	2461.2	4101.2	301.6	4402.8	6864.0
1979	2534.8	4093.2	263.1	4356.3	6891.1
1980[c]	2598.2	4358.2	242.1	4620.2	7218.4

[a]Milk sold off farms as reported by the first receiver.

[b]In milk equivalent.

[c]Preliminary.

Note: Farm sales prior to 1975 were derived by converting dairy products back to their milk equivalents. Beginning in 1975, published figures represent milk production sold off farms to first receivers, usually marketing boards in each province. Therefore, data on farm sales before 1975 are not comparable with those of later years and are not included in this table.

Source: Statistics Canada, 1975-79.

cream deliveries to plants rose about 18 percent from the previous year's level. This increase resulted in an accumulation of butter stocks above desirable levels, and skim milk powder stocks reached an all-time high when prices on world markets were disastrously low. In view of these circumstances it was necessary to make adjustments in MSQ to ensure a supply and demand balance.

At the beginning of the 1976-77 dairy year, quotas were reduced 18 percent to 44.3 million hectolitres from the 1975-76 MSQ allocation of 53.57 million hectolitres. This was intended to bring farm deliveries of industrial milk and cream more in line with domestic market requirements. Levies on over-quota deliveries were increased substantially. As a result, milk output and farm sales began decreasing in June 1976 and continued to do so through the second half of 1977. Further adjustments to the 1976-77 dairy program were made in October 1976 when the MSQ was increased 4 percent to 46.12 million hectolitres to assist producers who had been hardest hit by changes in production requirements. Because domestic requirements in the 1977-78 dairy year had declined further, some MSQ withdrawal and production adjustment was necessary. In July 1977 the Canadian Milk Supply Management Committee called for a 2-percent reduction in the national MSQ, and Canadian requirements were established at 43.2 million hectolitres, resulting in an MSQ of 45.72 million hectolitres after application of the sleeve.

Farm sales of industrial milk and cream fluctuated in the early months of 1978, but by mid-year the downturn was well established. The national herd size declined because of a brisk export market for live cattle, relatively high beef prices, and increased productivity per cow. Total farm sales of milk in 1979 were little changed from 1978 levels. Milk and cream sales for industrial use decreased 1 percent and milk for fluid use increased 3 percent. In the late summer months of 1979, however, milk production began to increase and continued to do so through the first half of 1980. Incentives designed to encourage a more even seasonal distribution of industrial milk shipments began to have some effect in the 1979-80 dairy year. These incentives included a change in the dairy year. Incentives at provincial levels, through subsidies for winter milk production and quota allocation policies, allowed greater volumes of production under quota during the winter. Because the 1978-79 dairy year was for a 16-month period, it is difficult to compare developments in the MSQ system with those in preceding 12-month dairy years (Table 2). However, demand conditions for dairy products remained relatively constant between the 1977-78 and 1979-80 dairy years as the MSQ for 1979-80 was identical with that established for the 1977-78 dairy year.

Although data on 1970 farm sales are not comparable with data after 1974 because of a change in the method of collecting statistics, estimates indicate that farm sales in 1979 were about 7 percent less than in 1970. Farm deliveries of all milk and cream have been approximately 6800 to 7000 million litres a year since 1975 (Table 1).

Not only did milk and cream sales decline in the 1970s, so did the number of producers supplying these products. A relatively stagnant market situation and rapid

TABLE 2. MARKET SHARING QUOTA ENTITLEMENT BY AREA, 1974-75 TO 1980-81

Area	1974-75	1975-76	1976-77	1977-78	1978-79[ab]	1979-80[bc]
			million hectolitres of milk equivalent[d]			
Prince Edward Island	0.94	0.84	0.64	0.86	1.24	0.86
Nova Scotia	0.55	0.52	0.54	0.55	0.77	0.55
New Brunswick	0.60	0.57	0.59	0.61	0.87	0.61
Quebec	27.65	25.36	22.28	21.92	31.36	21.92
Ontario	19.12	16.46	14.55	14.32	20.18	14.32
Manitoba	2.64	2.34	1.81	1.78	2.52	1.78
Saskatchewan	1.99	1.76	1.15	1.19	1.69	1.19
Alberta	4.86	4.30	3.12	3.07	4.31	3.07
British Columbia	1.56	1.44	1.44	1.42	1.96	1.42
Canada	59.92	53.57	46.12	45.72	64.90	45.72

[a]Quota for the 1978-79 dairy year was for 16 months – April 1, 1978 to July 31, 1979.
[b]Excludes special export quota.
[c]Provincial and Canadian quotas increased 2 percent from these values on January 24, 1980.
[d]Based on the standard at 3.6 kg of butterfat per hectolitre.

Source: C.D.C. records (early years converted from pounds of butterfat to hectolitres of milk).

Note: Totals may not add because of rounding.

technological change meant that the market could be supplied by fewer producers. Many producers retired, others opted for alternative employment. At the beginning of the 1970-71 dairy year, there were about 102 800 industrial milk and cream shippers registered with the Canadian Dairy Commission (C.D.C.). Fluid milk shippers, who were not registered by the C.D.C. at that time, were estimated at 18 500, making a total of 121 300 producers. By April 1980, the total number of producers (including fluid) shipping milk and cream had dropped to 50 600, a decline of 58 percent from 1970-71 levels. The number of industrial milk and cream producers had dropped to 30 000 and fluid shippers had increased to about 20 600. However, the method of obtaining the number of producers has changed from the number registered with the C.D.C. to the number actually shipping milk or cream.

MARKET SHARING QUOTA

In 1969 the Dairy Farmers of Canada initiated an MSQ plan for industrial milk and cream. The C.D.C. and the milk marketing agencies of Ontario and Quebec established a comprehensive milk marketing plan to begin on January 1, 1971. The agreement included a MSQ system for industrial milk from bona fide industrial shippers and that portion of industrial milk shipped by fluid producers which is used in manufacturing dairy products, such as butter and skim milk powder and cheese. The plan also covered cream producers in Quebec, and Ontario cream shippers entered on April 1, 1971. All provinces had entered the plan by April 1, 1974. The quotas were basically established on each producer's deliveries of industrial milk or cream in the 1969-70 year or his subsidy quota, whichever was greater. Previously, subsidies were paid on industrial milk and cream only and fluid milk shippers were not eligible. Subsidy quotas for industrial milk had been in effect since the beginning of the 1967-68 dairy year. Holdbacks from subsidy payments to finance exports of surplus dairy products were introduced in 1966-67.

The initial agreement on market sharing provided that the C.D.C. would pay the full rate of subsidy without holdback to eligible producers coming under the MSQ in the provinces involved, and that the provincial agencies would have a levy collected on each producer's deliveries. The amounts collected were to be remitted to the Commission.

In 1976-77, the Canadian Milk Supply Management Committee determined that a 5-percent sleeve (over national requirements) was necessary to obtain the desired production level in relation to the MSQ. There were always some producers leaving the industry and there was normally a time lag before their quotas were obtained by other producers. Total MSQ thus became 5-percent higher than estimated requirements. In addition, a small amount of quota for provincial adjustments was included in the MSQ. Producers received their individual quotas, including the 5-percent sleeve, from their provincial milk or cream agencies.

An export development plan was worked out in the summer of 1979 to allow an extra quota on a national basis to help the industry develop new export markets.

TABLE 3. CREAMERY BUTTER AND SKIM MILK POWDER REMOVED FROM THE MARKET THROUGH PRICE SUPPORT AND RELATED PROGRAMS, CANADA, 1970-71 TO 1979-80

	Butter			Skim Milk Powder		
Dairy Year[a]	Total Butter Production	Federal Agency Purchases[bc]	Purchases as % of Production	Total Milk Powder Production	Federal Agency Purchases[c]	Purchases and Export Assistance as Percentage of Production
	million kilos		%	million kilos		%
1970-71	144.7	30.7	21.2	157.1	52.0	33.1
1971-72	131.5	20.2	15.4	139.2	47.2	33.9
1972-73	128.1	25.0	19.5	152.0	93.7	61.6
1973-74	112.7	18.8	16.7	138.3	51.2	37.0
1974-75	107.1	19.1	17.8	142.6	78.3	54.9
1975-76	136.3	40.6	29.8	199.7	148.9	74.6
1976-77	104.9	31.1	29.6	142.5	103.7	72.8
1977-78	115.2	34.0	29.5	160.3	107.5	67.1
1978-79	105.2	26.7	25.4	130.1	80.0	61.5
1979-80	99.8	27.2	27.2	114.6	68.8	60.0

[a] April 1 to March 31.
[b] Purchases less butter imports. Imports were as follows:

1971-72 – 5.1 million kilos
1972-73 – 11.7 million kilos
1973-74 – 24.1 million kilos
1974-75 – 22.4 million kilos
1977-78 – 5.2 million kilos

[c] Source: C.D.C.

All provinces did not participate in the plan. Producers participating in 1979-80 received a subsidy of \$3.02/hL for milk produced to fill the special quota (the regular subsidy was \$6.03/hL) and paid a special contingency levy of \$0.11/hL.

The national MSQ entitlement in 1979-80 was 45.72 million hectolitres of milk equivalent, excluding the special export quota, with Quebec accounting for 48 percent of the total and Ontario 31 percent (Table 2). The MSQ was increased 2 percent on January 28, 1980 to accommodate increased demand for milk for dairy products, notably cheese and butter.

A feature of the 1979-80 policy was the change in the MSQ period and the dairy year. The peak milk production period is normally the late spring and early summer when dairy cattle are out on pasture. In the past, some producers had used too much of their quota in the summer and were short of quota the following winter when additional supplies were needed. By starting the quota period in late summer, producers were less likely to be short of quota during the winter. The new MSQ period and the new dairy year began on August 1, 1979. This will facilitate additional production during the winter.

DAIRY SUPPORTS

The federal government, through the C.D.C., continued to support the industry during the 1970s by removing surplus butter and skim milk powder from the market (Table 4). The offer-to-purchase program for butter assured consumers of an adequate supply of dairy products on a year-round basis by removing surplus butter in the spring and summer and selling it back to the butter trade later in the year. The federal government assumed the marketing costs associated with the offer-to-purchase program. In general, most of the butter purchased was sold for domestic consumption, although surplus butter was exported in 1971 and again in 1976 and 1977. The C.D.C. also imported butter when domestic supplies were insufficient for requirements and again under the butterfat exchange program (Table 3). First Grade Spray process skim milk powder surplus to domestic requirements was purchased in carlots by the Commission, largely for export.

In 1970-71 some cheddar cheese was purchased under price support, but as the market price for cheddar remained well above the support prices during the decade, no further cheese purchases were required.

TABLE 4. SUPPORT PRICES FOR BUTTER, SKIM MILK POWDER, AND INDUSTRIAL MILK, CANADA, 1970-71 TO 1980-81

Dairy Year[a]	Butter	Skim Milk Powder	Industrial Milk Target Returns[b]
	$ per kilogram		$ per hectolitre
1970-71	1.43	0.44	11.00
		0.53[c]	
1971-72	1.43	0.53	11.89
	1.50[d]	0.57[d]	12.45[d]
1972-73	1.50	0.64	12.91
1973-74	1.56	0.77	14.86
		0.84[e]	15.20[e]
1974-75	1.70	1.10	19.28
	1.87[f]	1.19[f]	21.35[f]
	1.98[g]	1.30[g]	22.73[g]
1975-76	2.27	1.41	25.00
1976-77	2.38	1.50	25.97
1977-78	2.60	1.54	26.90
	2.69[h]	1.59[h]	27.63[h]
1978-79	2.80	1.63	28.17
	2.91[i]	1.72[i]	29.35[i]
1979-80	3.02	1.79	30.15
	3.13[j]	1.84[j]	31.01[j]
	3.26[k]	1.97[k]	32.62[k]
	3.34[l]	2.01[l]	33.31[l]
1980-81	3.51[m]	2.13[m]	34.61[m]

[a] The dairy year was changed from April 1 to August 1, effective August 1, 1979. The data for 1979-80 include data for the period April 1, 1979 to July 31, 1980.
[b] Effective market support 1970-71 to 1974-75. Target returns as such introduced in 1975-76.
[c] Effective February 8, 1971.
[d] Effective August 16, 1971.
[e] Effective August 1, 1973.
[f] Effective August 1, 1974.
[g] Effective January 24, 1975.
[h] Effective January 1, 1978.
[i] Effective January 2, 1979.
[j] Effective August 1, 1979.
[k] Effective January 1, 1980.
[l] Effective April 1, 1980.
[m] Effective August 1, 1980.

Note: Statistics for this table have been converted to metric units and rounded for the years 1970-71 to 1978-79; hence they may not represent exact values.

Source: C.D.C. policy announcements.

The Commission does, however, provide financial assistance from levy collections to cheese exports when required, mostly to the United Kingdom.

The offer-to-purchase price for butter, that is, the price at which the C.D.C. removes butter from the market, increased from $1.43/kg on April 1, 1970 to $3.02/kg on April 1, 1979, an increase of 111 percent. The offer-to-purchase price for skim milk powder increased during the same period from $0.44/kg to $1.79/kg, a rise of 307 percent (Table 4). The market support for industrial milk increased from $11.00/hL on April 1, 1970 to $30.15/hL on April 1, 1979 (Table 4).

The Returns Adjustment Formula

The support level for industrial milk was established under a new policy at the beginning of the 1975-76 dairy year at the base return of $25.00/hL. This established a base target return which would be adjusted by a formula in relation to changing production costs. The Returns Adjustment Formula comprises an index of cash input prices to adjust cash costs and the Consumer Price Index as a measure of changes in the earnings of operator and family labor.[2] A weight of 45

[2] D. Peter Stonehouse, "Government Policies for the Canadian Dairy Industry," *Canadian Farm Economics* 14 (February-April 1979): 1-11.

TABLE 5. SUBSIDY PAYMENTS TO INDUSTRIAL MILK PRODUCERS AND LEVIES, CANADA, 1970-71 TO 1980-81

Dairy Year[a]	Federal Subsidy	Levy on In-Quota Deliveries	Levy on Over-Quota Deliveries[b]	Levy on Fluid Milk Deliveries	Contingency Levy	Export Quota Levy
			$ per hectolitre of milk			
1970-71	2.84	0.59	5.45	–	–	–
1971-72	2.84	0.59[c]	5.45[c]	–	–	–
		0.23[d]	4.65[d]			
1972-73	2.84	0.23	4.65	–	–	–
			3.40[e]	–	–	–
1973-74	3.29	0.68	3.40	–	–	–
	4.56[f]	0.23[f]				
1974-75	5.22	0.34	3.40	–	–	–
	5.81[g]					
1975-76	6.03	1.02	9.07	–	–	–
		1.47[h]				
1976-77	6.03	3.06	19.51	–	–	–
1977-78	6.03	2.72	15.88	0.57		
1978-79	6.03	2.27	17.01	0.45	0.45	–
1979-80	6.03	2.27	17.01	0.45	0.45	–
	3.02[ij]		18.16[i]		0.57[i]	0.11[i]
1980-81[a]	6.03	2.80	18.16	–[k]	–	0.16

[a] The dairy year was changed from April 1 to August 1, effective August 1, 1979. The data for 1979-80 include data for the period April 1, 1979 to July 31, 1980.
[b] For deliveries in excess of MSQ.
[c] April 1, 1971 to May 1, 1971.
[d] June 1, 1971 to March 31, 1972.
[e] Effective June 21, 1972.
[f] Effective August 1, 1973.
[g] Effective August 1, 1974.
[h] Effective July 1, 1975.
[i] Effective August 1, 1979.
[j] Export quota.
[k] A deduction representing the subsidy on a volume of industrial milk equal to 5 percent of each producer's Class 1 sales.

Note: Statistics for this table have been converted to metric for the years 1970-71 to 1978-79; hence they may not represent exact values.

Source: C.D.C. policy announcements.

percent was given to the cash cost index and 35 percent to the labor earnings component. At the time of the annual review of C.D.C. programs the target price was to be adjusted on the basis of the formula and several judgement factors, including significant changes in dairy product stock levels, changes in dairy producers' returns in other milk producing countries, and major changes in competitive processing costs. The judgement factors carrying a weight of 20 percent in the formula have had a neutral application to date.

If during a dairy year between 1975-76 and 1978-79 the Returns Adjustment Formula indicated a change of more than 4 percent from the existing target support level, an interim returns adjustment would have been made. This adjustment would have been implemented through price support changes and judgement factors would not be considered. Interim adjustments would have been made only after an interval of at least 3 months in relation to the previous adjustment. However, no adjustment in target returns within the dairy year was necessary, reflecting increased producer costs, until January 1, 1978. A modification beginning with the new dairy year on August 1, 1979 was made in regard to interim adjustments with the announcement that farmers' returns would be adjusted whenever the cost formula showed a change of more than 2 percent during the dairy year. It was also agreed that no more than two adjustments, at least 3 months apart, would be made in the dairy year.

The target price for industrial milk comprises the market price paid at the plant for milk used in the manufacture of butter and skim milk powder, plus a direct federal

subsidy paid to producers (Table 5). There has been no change in the subsidy rate since the beginning of the 1975-76 dairy year, thus an increasing percentage of the target price is originating from the market. In 1970-71 about 26 percent of the target price was from the federal subsidy; in 1979-80 (April 1, 1979) the subsidy represented 20 percent of the target price and on August 1, 1980 it represented only 17 percent. The target price (target returns) is an objective price and is not a guarantee to the producer because of the variation in processors' costs, blend prices, and so forth.

The net cost of the federal dairy industry support program in 1970-71 was about $113 million. In 1976-77 the net expenditure totaled $443.5 million and included provision for the loss on the export equalization account of $159.7 million. By 1979-80 the net cost was $296 million and $297 million was budgeted for 1980-81 (Table 6).

The Levy Structure

Levies are specific instruments imposed to cover the different situations in which producers are liable for disposal costs. The following are the types of levy associated with dairy supports: in-quota levy, over-quota levy, fluid (skim-off) levy, and contingency levy for sleeve production. With the introduction of the export quota program in 1979-80 an export quota levy was established (Table 5).

TABLE 6. NET COST OF THE DAIRY INDUSTRY PRICE SUPPORT PROGRAM, CANADA, 1970-71 TO 1980-81

Dairy Year	Net Expenditure on Price Supports[a]
	$'000
1970-71	112 836
1971-72	102 440
1972-73	105 884
1973-74	150 924
1974-75	246 201
1975-76	283 721
1976-77	443 502[b]
1977-78	292 304
1978-79	406 222[c]
1979-80	296 367
1980-81[d]	297 100

[a] Includes administrative costs.
[b] Includes extraordinary item provision for loss on the export equalization account of $159.7 million.
[c] April 1, 1978 to July 31, 1979 (16 months).
[d] Budgeted.

Source: C.D.C.

The in-quota levy and the fluid levy are calculated on the basis of disposal of surplus dairy products, mostly skim milk powder, which arises from the production of industrial milk within quota to meet domestic needs for butterfat. The other levies are calculated on the basis of shipments surplus to Canadian requirements. The differences between the Canadian prices and world price are used to determine levy size. Levies are not penalties but a means to cover financial liabilities. The levies do not cover administrative costs, transportation costs, and so forth. These are paid for by the C.D.C.

A special contingency levy was introduced in 1978-79 (Table 5) to cover the disposal costs of any in-sleeve production that was surplus to Canadian requirements. No producer would have to pay for the disposal of sleeve production of another producer and no province would have to pay for sleeve production in another province. The contingency levy would be refunded to the individual producer at the end of the dairy year if he had not produced in the sleeve or if production into the sleeve was needed for Canadian requirements. In 1979 the entire contingency levy collected during the 16-month period ending July 31, 1979 was returned with interest to dairy farmers, because all the milk produced in the sleeve was needed to fill Canadian requirements for industrial milk products.

The levies collected from producers to cover the costs associated with dairy product exports for 1980-81 were changed from those previously in effect. The contingency levy, for in-sleeve shipments, was eliminated and the levy contribution from the fluid milk sector was modified. The fluid levy was changed from a set amount to a deduction representing the federal subsidy on a volume of industrial milk equal to 5 percent of each producer's Class 1 sales.

Funds recovered by the C.D.C. through producer levies rose rapidly in the second half of the 1970s (Table 7). Levy collections fluctuated during the decade from a low of $8 million in 1973-74 to a high of about $150 million in 1977-78.

INTERNATIONAL TRADE

Cheese Trade

Cheddar cheese exports, largely to the United Kingdom, were 13 600 t in 1970 and 13 300 t in 1971.[3] The United Kingdom's entry into the EEC in 1973 imposed

[3] V. McCormick, "The Cheese Industry in Canada," *Canadian Farm Economics* 14 (August 1979): 3-7.

a high import levy and for the next 2 years Canada's cheese exports into that market were insignificant. Canada's concern over the loss of traditional exports led to an agreement with the EEC for special access terms for Canadian cheddar in 1975. Despite this agreement, total Canadian cheddar exports during the rest of the decade were very small. Canada has obtained freer access to the EEC market as a result of the Multilateral Trade Negociations within the framework of the General Agreement on Tariffs and Trade concluded at Geneva in April 1979. This agreement, which became effective on January 1, 1980 established an annual quota of 2 750 t for aged Canadian cheddar at least 9 months old. A fixed import levy of 10 European units of account per 100 kg (19.5 cents Canadian per kg at September 1, 1980 currency levels) is assessed. Exports to the United States are also limited by quota restrictions. The quota for all cheese, except soft cured varieties, to the United States is 2 044 t.

TABLE 7. FUNDS RECOVERED BY THE C.D.C. THROUGH PRODUCER LEVIES, 1970-71 TO 1979-80

Dairy Year	Funds Recovered
	$'000
1970-71	28 826
1971-72	8 518
1972-73	8 393
1973-74	8 012
1974-75	12 743
1975-76	60 848
1976-77	117 711
1977-78	149 760
1978-79[a]	148 244
1979-80	110 276

[a]Sixteen months.

Canada established a global import quota for all types of cheese in 1975. The quota limited imports to approximately 22 700 t/year but with no more than 453 000 kg allocated to cheddar cheese. The quota was reduced to approximately 20 400 t beginning April 1, 1978.

The Butterfat Exchange Program

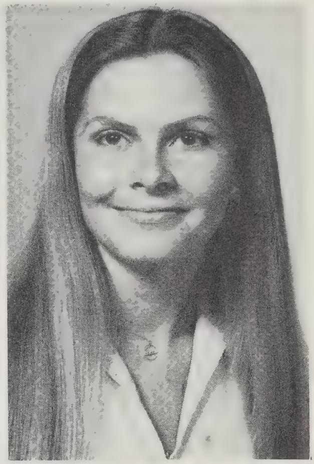
A marketing strategy, the butterfat exchange program, was introduced in 1977-78. Under this program, the C.D.C. exported dairy products – mostly evaporated whole milk – and imported butter at the world price to the equivalent amount of butterfat exported. The program reduced the loss on skim milk powder exports. Instead of importing butter in the 1978-79 dairy year, domestic butterfat from producers who had produced more than their milk quotas and paid over-quota levies was devalued to world prices and used in the program. Because of sufficient butter stocks, no butter was imported for the program in the calendar year 1979 or in the first 11 months of 1980.

CONCLUSION

Canadian dairy policy has been instrumental in keeping industrial milk deliveries well in balance with market requirements on a butterfat basis. It has created a stable environment for producers, particularly since the introduction of the Returns Adjustment Formula for industrial milk in 1975-76. The basic goals of dairy policy appear to have been achieved, but the net costs of the policy are substantial. The challenge for the 1980s will be to sustain increases in efficiency.

MEASURING STRUCTURAL CHANGE IN THE CANADIAN FARM INDUSTRY

A recent study measured real structural change in the Canadian farm industry by removing the distorting influence of resource and product price fluctuations. The study was carried out on a provincial basis for the 1966-76 period. This report describes the methodology used, presents the results in tabular form, and highlights some of the study's findings.



*W. Jones and C. Buckley**

INTRODUCTION

Farm industry structure, in the context of the present study, refers to the aggregate socio-economic composition of the farm sector, that is, the number of farm units, their distributional characteristics, and the concomitant allocation of resources. Changing farm industry structure has become the subject of increasing concern in the post-war period as various internal and external influences combine to alter the traditionally stable characteristics of the industry. The decline in the number of farms and the trend towards larger economic units have probably received the most attention, although other structural changes such as increased capital values, reduced labor requirements, and the growing incidence of part-time farming have also generated considerable interest.

The decade from 1966 to 1976, the period examined in this study, was one of significant structural change in the farm industry. As evidence, 282 275 farm operators left the industry during the period and 190 325 new farm operators entered the industry, resulting in a net decrease of 21 percent in the number of farms. Average farm sales increased 87 percent in real terms over the same period while real capital value per farm increased 70 percent. Moreover, such changes, while significant in their own right, mask even greater distributional adjustments within the industry.

Many of the forces determining these structural changes are believed to be largely exogenous to the farm industry itself.[1] The availability and cost of purchased inputs, cost of credit, non-farm employment opportunities, and environmental controls are examples of the diverse range of external factors affecting farm industry structure.[2] Internal factors also play a role in structural change with demographic and institutional variables, such as farm population, age distribution, education, and agricultural policies and programs being at least

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[1] For further discussion see H.O. Carter and W.E. Johnston, "Some Forces Affecting the Changing Structure, Organization and Control of American Agriculture," *American Journal of Agricultural Economics* 60 (1978) 5: 738-747; and A.E. Buckwell and D.M. Shucksmith, "Projecting Farm Structural Change," *Journal of Agricultural Economics* 30 (1979) 2: 131-142.

[2] H.F. Breimyer, "The Changing American Farm," *Annals of the American Academy of Political and Social Science* 429 (1977): 12.

as important as such economic factors as the level of output and product prices.[3]

Policymakers must have a knowledge of farm industry structural change because farm industry structure affects virtually all national goals that directly or indirectly relate to agriculture.[4] For example, the producer oriented goal of a fair level of producer return involves optimising returns to the resources of land, labor, and capital used on farms. Movement towards this goal may require a recombination of resources within the industry for their productive earnings to be increased. Structural change analysis indicates the direction and rate of change in resource use so that the need for government assistance, if any, can be examined. Similarly, the consumer oriented goal of reasonable food prices is influenced by farm industry structure because food prices are related to the economic efficiency of production. Achievement of this goal may, for the sake of illustration, require the expansion of certain production activities in those regions possessing comparative advantage. Farm industry structural analysis can indicate to the policymaker where such advantages may exist and whether or not the industry is moving towards the development of these advantages. Finally, structural change can also be examined in relation to some of the more broadly oriented goals of full employment, conservation, balanced rural–urban population, improved quality of rural life, and so forth, although the impact on these higher level goals and the subsequent policy implications are less clear.

There have been many studies in the area of farm industry structure. While a thorough review is outside the scope of this article, a good summary is available in a review by Willis.[5] Recent Canadian research provided the direction for the present study. Jones and Tung examined net changes in farm numbers, size, and resource use during the 1961-71 period, finding unequal rates of change among economic classes of farms and between geographic regions.[6] The same authors also conducted a study of farm adjustment in Saskatchewan. This work documented evidence that the structural characteristics of farm units varied according to whether the farms were in an expanding, declining, or stable operation phase.[7] MacMillan and Gislason tested some of the economic variables that influence the variation in farm numbers in connection with a study of farm operator mobility.[8] They found operator age, capital stock, off-farm work, and supplies of hired labor to be significant and related to income classes. Bollman explored the relationship between off-farm work and the rate of entry into and exit from the farm industry.[9] He was able to show that both entry and exit were influenced by the level of off-farm work.

From these studies, changes in such structural variables as farm numbers, sales, value of capital, land use and tenure, hired labor, operator age, and off-farm work have been shown to have policy and program implications. Similarly, it has been seen that disaggregation by province, economic farm size, and phase of operation (that is, entrants, exits, and expanding, declining, and stable farm size) is a useful format for structural change analysis. The present study was initiated to measure the changing structure of the Canadian farm industry, in this context, during the 10-year 1966-76 period.

A major concern was the distorting influence of price changes over time. For example, the perceived movement of farm operators among economic classes (determined by value of sales) can largely be explained by changes in product prices. Much of the apparent accumulation of capital on farms is also attributable to respective price increases which inflate the value of capital stock. For this study a constant dollar set of economic classes spanning the three most recent census years – 1966, 1971, and 1976 – was developed. This permits a more valid comparison of farm industry structure over time. The economic structural variables were also converted into constant dollar amounts. Thus, the structural changes identified in this paper are relatively free of the effects of temporal price movements.

[3] A.E. Buckwell and D.M. Shucksmith, "Projecting Farm Structural Change," *Journal of Agricultural Economics* 30 (1979) 2: 132.

[4] For a discussion of farm industry structure in relation to the achievement of agricultural policy goals see *Orientation of Canadian Agriculture,* an Agriculture Canada Task Force Report, Vol. 2, 1977, p 10-31.

[5] J.D. Willis, An Overview of Structural Change and Adjustment in Canadian Agriculture, an unpublished Agriculture Canada working paper, March 1977.

[6] W. Jones and F. Tung, "A Regional Comparison of Structural Change and Resource Use in the Canadian Farm Industry 1961-1971," *Canadian Farm Economics* 12 (October 1977): 20-31.

[7] F. Tung and W. Jones, Factors Affecting the Farm Adjustment Process and Structural Changes in the Saskatchewan Farm Industry, a paper presented at the Canadian Agricultural Economics Society Conference, Guelph, Ontario, 1977.

[8] J.A. MacMillan and G.S. Gislason, "Canadian Farm Operator Mobility Analysis 1961-1971," *Canadian Journal of Agricultural Economics* 28 (1980) 2: 11-25.

[9] R. Bollman, The Contribution of Off-Farm Work by Farmers, a paper presented to the XVII International Conference of Agricultural Economists, Banff, Alberta, 1979.

TABLE 1. ECONOMIC FARM SIZE CLASSES, CANADA

Economic Class	1976 Census	1971 Census	1966 Census
	value of agricultural products sold — constant 1975 dollars		
1	less than 1 200	less than 601	less than 582
2	1 200 - 2 499	601 - 1 251	582 - 1 212
3	2 500 - 4 999	1 252 - 2 503	1 213 - 2 426
4	5 000 - 9 999	2 504 - 5 008	2 427 - 4 852
5	10 000 - 14 999	5 009 - 7 512	4 853 - 7 279
6	15 000 - 24 999	7 513 - 12 521	7 280 - 12 132
7	25 000 - 34 999	12 522 - 17 529	12 133 - 16 985
8	35 000 - 49 999	17 530 - 25 042	16 986 - 24 265
9	50 000 - 99 999	25 043 - 50 085	24 266 - 48 531
10	100 000 and over	50 086 and over	48 532 and over

The complete set of provincial tables tabulated for this study are in the appendix. A full description of the data is outside the scope of this paper. However, some highlights of structural change are briefly discussed to familiarize the reader with the tables' contents. To evaluate the study's results it is most important to understand the methodology used.

METHODOLOGY

Unpublished Census of Agriculture match data, developed by the Agricultural Division of Statistics Canada, provided the basis of the tabulations complied for this study.[10] The match data for the 1966-71 period were derived by matching the operators' names and addresses on the updated 1966 Central Register of Farms (excluding institutional farms) to those on the 1971 census list. The computer match was manually checked for errors and an attempt was made to allow for differences in spelling and the way in which addresses were reported.

The matched operators were assumed to have farmed throughout the 1966-71 period and are referred to as continuing farm operators. Those present in 1966, but unmatched in 1971, were classified as exiting operators and those present in 1971, but not in 1966, were grouped as entering operators. Information on each type of operator was obtained from tabulations of the responses to the census questionnaire. A comparable set of match data was developed for the 1971-76 period.

To analyze structural change in terms of farm size it was necessary to establish sets of farm size classes that would be suitable for comparisons across farm types and over time. The value of agricultural products sold, or gross sales, was considered the best available measure once the data were adjusted to account for the product price differentials of the three census years. The adjustment procedure involved defining farm size class limits for the most recent census year and then redefining these limits for the two previous census years so that all sets of farm size classes were in constant 1975 dollars.[11] For example, the smallest size class for farms on the 1976 census had a gross sales limit of 'less than $1200', while the corresponding smallest size classes for farms on the 1971 and 1966 censuses were 'less than $601' and 'less than $582'. The individual farm units on each census were then allocated to a farm size class according to reported gross sales.

The 1976 census obtained farm sales data for the 1975 calendar year. Similarly, the 1971 census recorded farm sales for the 1970 calendar year. The 1966 census, however, asked for values during the period June 1, 1965 to May 31, 1966. When converting sales classes to constant dollars, therefore, it was necessary to use farm product price indexes for 1965-66 and 1970 and to convert to 1975 rather than 1976 dollars. The index for 1966 was compiled by averaging the monthly farm product price indexes for the months of June 1965 through May 1966. This conversion was done by using separate indexes for Canada and the 10 provinces.[12]

[10] For more information consult Ray D. Bollman, *1966-71 Census of Agriculture Match: Methodology and Analysis of the Quality of the Match,* Agriculture Division, Statistics Canada, 1977.

[11] It was necessary to use the economic classes from the 1976 census as the base because information on the 1976 census questionnaire was insufficient to permit conversion to an earlier base. The economic classes on the 1976 census were based on value of sales in 1975 (Table 1).

[12] As Newfoundland indexes were not available, proxy indexes were derived in all cases by averaging the indexes of the Maritime Provinces. In addition, Canadian indexes did not include a Newfoundland component, an omission not likely to be significant.

TABLE 2. COMPARISON OF AVERAGE FARM SALES BY ECONOMIC CLASS AND CLASS MIDPOINT FOR CANADA, 1970

Economic Class	Class Midpoint	1970 Average Farm Sales (1975 dollars)	Midpoint/Average Variation
$	$	$	%
1 200 - 2 499	1 850	1 896	−2.5
2 500 - 4 999	3 750	3 747	+.1
5 000 - 9 999	7 500	7 297	+2.7
10 000 - 14 999	12 500	12 074	+3.4
15 000 - 24 999	20 000	18 968	+5.2
25 000 - 34 999	30 000	28 873	+3.8
35 000 - 49 999	42 500	41 354	+2.7
50 000 - 74 999	62 500	61 154	+2.2
75 000 - 99 999	87 500	88 606	−1.3

TABLE 3. AVERAGE FARM SALES FOR FARMS WITH SALES OF $100 000 AND OVER

Province	1970 Actual Average Sales (1975 dollars)	1975 Estimated Average Sales
	$	
British Columbia	216 176	230 237
Alberta	254 088	321 087
Saskatchewan	207 512	465 182
Manitoba	250 349	335 319
Ontario	221 808	231 759
Quebec	228 877	425 850
New Brunswick	200 748	261 651
Nova Scotia	242 706	214 646
Prince Edward Island	181 874	212 677
Newfoundland	282 240	310 957

The 1976 census provides information on the number of farms within each farm sales class but does not indicate the actual value of sales on individual farm operations. To examine the changing level and distribution of farm sales over time, it was therefore necessary to estimate the value of sales by economic class for 1975. These estimates were determined in the following manner.

For economic classes with both upper and lower limits ($1200-$2499, $2500-$4999, and so forth), the midpoint of the range was used as the average value of sales for farms in that particular class. The product of this average and the number of farms in the class became the estimated value of sales for the class. This procedure was tested by comparing actual average sales by economic class in 1970 with the class midpoint. As indicated in Table 2, the percent differences between average sales and class midpoints are quite small.

The less than $1200 sales class accounted for less than 0.4 percent of total sales in 1966 and 1971 and is therefore relatively insignificant. For 1975, average sales per farm for this class was set at $800. Sales of the $100 000 and over sales class are more critical. Estimates were based on the 1975 total farm cash receipts reported by Statistics Canada (Table 3).

The final step in preparing the data for this study involved the use of appropriate product and input price indexes to convert actual values of gross sales and capital stock into constant dollar amounts. As was the case for converting the size of class limits, the values associated with the 1966 and 1971 census years were adjusted to correspond with the unadjusted values of the 1976 census.

Capital values reported in the census represented the values as of the day the census was taken. Land and building values were adjusted using an index created from the Value of Farm Lands and Buildings survey carried out by the Agriculture Division of Statistics Canada. Machinery and equipment values were adjusted using the weighted machinery replacement and motor

STRUCTURAL CHANGE MATRIX FORMAT (1971-76)

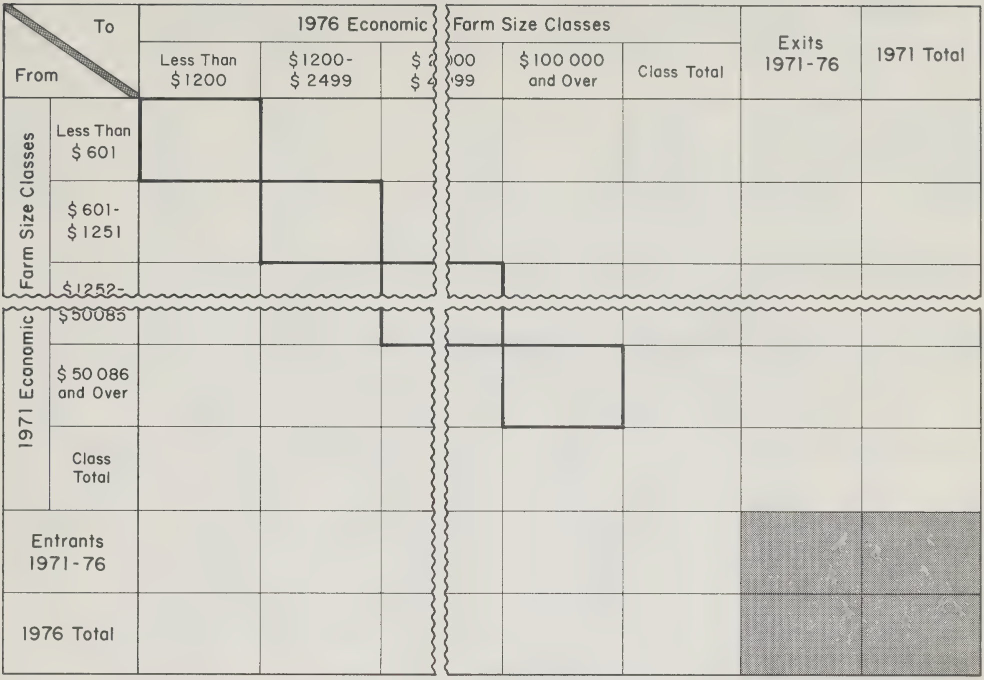

Figure 1

vehicle replacement subindexes of the farm input price index. Livestock and poultry values were adjusted using the cattle subindex of the farm input price index. The cattle subindex was the best measure of livestock and poultry price changes that provided continuity back to 1966. These procedures were again carried out for Canada and each of the 10 provinces.

The structural information provided by the transformed match data was generated in a matrix format. These matrices indicate the change in distribution of a given structural variable (farm numbers, capital stock, and so forth) among farm size classes during either the 1966-71 or 1971-76 period (Figure 1). All farm operators who reported the same farm size at the beginning and end of a period appeared in cells along the diagonal of the matrix. Operators who increased their farm size were in one of the cells above the diagonal. Operators who decreased their farm size appeared in one of the cells below the diagonal.

The matrix also shows the distribution of a given structural variable among farm size classes for entering and exiting farm operators. For entrants, data are, of course, only available for the census year at the end of the period. For exiters, data are only available for the census year at the beginning of the period.

SOME ASPECTS OF FARM INDUSTRY STRUCTURAL CHANGE, 1966-76

The complete set of provincial tables measuring structural change, net of price fluctuations, is in the appendix. Rather than attempt to describe the myriad data presented in those tables, some of the more significant aspects are briefly discussed. The observations are supported by tables which condense and highlight the content of the appendix tables.

Farm Numbers

One of the most commonly referred to structural changes is the movement to larger farms. In an economic sense this implies a higher level of output and is generally attributed to new technology which has raised the optimum farm size and to declining profit margins. The best way to observe this change is to examine the distribution of farms by level of sales

TABLE 4. DISTRIBUTION OF FARMS BY ECONOMIC CLASS, CANADA

Economic Class	Current Dollars[a]			Constant (1975) Dollars		
	1966	1971	1976	1966	1971	1976
$	%					
1 200 - 2 499	18.1	13.7	10.4	8.8	7.6	10.4
2 500 - 14 999	66.9	62.8	39.8	53.3	45.2	39.8
15 000 - 49 999	12.0	20.0	35.2	32.3	36.9	35.2
50 000 and over	3.0	3.5	14.6	5.6	10.3	14.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Current dollar distribution from Statistics Canada, *Census of Agriculture*.

TABLE 5. MOVEMENT OF FARM OPERATORS BY AREA, 1971-76[a]

Area	Movement of Operators				
	Exiting Operators	Decreasing Farm Size	Stable Farm Size	Increasing Farm Size	Entering Operators
	no.				
B.C.	8 755	2 810	3 125	3 670	9 780
Prairies	55 365	35 140	30 865	52 775	44 885
Ontario	34 550	19 355	18 270	22 475	28 630
Quebec	23 845	13 275	10 795	13 235	14 200
Atlantic	7 410	3 775	3 075	2 695	4 870
Canada[b]	129 920	74 345	66 140	94 880	102 370

[a]Change in farm size based on movement among constant (1975) dollar economic classes.
[b]Columns may not total because of rounding.

(economic class) over time. However, increasing product prices will shift farms to higher economic classes even if their output, in physical terms, remains constant or declines. Consequently, the movement to larger farms is often exaggerated because the economic classes are measured in nominal terms. The constant (1975) dollar economic classes used in this study attempt to circumvent this distortion.

Table 4 indicates the changing distribution of farms by economic class and illustrates the differences in the distribution of farms by current and constant dollar economic classes. The constant dollar classes are condensed from the appendix to coincide with the current dollar classes published in the Census and to approximately distinguish between non-commercial, small, medium, and large farms. Since our constant dollar classes are expressed in 1975 dollars, the distribution of farms in 1976 is the same for current and constant dollar economic classes.

Looking at farms with sales of $1200 to $2499, current dollar measurement portrays a declining proportion of total farms, while in constant dollars the proportion of farms in this class remained relatively constant between 1966 and 1971 and increased in 1976. An increase of almost 200 percent in the proportion of farms in the $15 000-$49 999 sales class between 1971 and 1976 reduces to an increase of less than 10 percent when the economic classes are converted to constant dollars.

Although the movement to farms of larger economic size is less dramatic when the effects of product price increases are removed, a significant change in the size distribution of farms is still evident. This is most evident from the proportion of farms in the highest constant dollar class which more than doubled from about 6 percent in 1966 to about 15 percent in 1976.

Of course not all movement within the industry is towards larger economic units. Whether by circumstance or intention, many farm operators have maintained a stable farm size or have reduced the size of their operations. These situations, combined with farm industry entrants and exits, make up the entire spectrum of farm operator movement between two points in time. The data in Table 5 illustrate the extent of operator movement among constant dollar economic classes

TABLE 6. AVERAGE SALES AND CAPITAL VALUE PER FARM BY AREA

Area	Average Value of Farm Sales			Average Value of Farm Capital		
	1966	1971	1976	1966	1971	1976
	constant 1975 dollars			constant 1976 dollars		
B.C.	13 172	19 167	21 294	135 345	180 234	183 501
Prairies	17 928	23 700	34 488	107 871	133 756	188 233
Ontario	18 141	25 435	29 926	156 359	156 581	190 566
Quebec	10 406	17 398	23 879	49 210	62 595	80 877
Atlantic	8 458	15 522	20 483	36 975	54 689	80 921
Canada	15 805	22 566	29 551	98 422	125 775	167 604

TABLE 7. DISTRIBUTION OF FARM SALES, CAPITAL, LAND, AND LABOR BY ECONOMIC CLASS, CANADA

Constant 1975 Dollar Economic Classes	Value of Farm Sales		Value of Total Capital		Acres of Improved Land		Weeks of Hired Labor	
	1966	1976	1966	1976	1966	1976	1966	1976
	%							
less than 1 200	0.4	0.3	5.0	4.0	3.0	1.2	1.2	.8
1 200 - 2 499	0.9	0.6	3.0	4.2	2.3	2.8	1.0	1.5
2 500 - 14 999	22.0	9.3	32.2	22.0	34.0	22.0	15.4	10.0
15 000 - 49 999	44.5	30.5	43.4	35.4	47.5	42.8	36.0	23.1
50 000 and over	32.2	59.3	16.4	34.4	13.2	31.2	46.4	64.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

during the 1971-76 period. Disaggregation by province or region is used to indicate the variation in structural change by geographic area.

It can be seen from comparing the number of entrants to the number leaving the industry that the total number of farms declined between 1971 and 1976 in all regions except British Columbia. In that province, 50 percent of those operating farms in 1976 had entered the industry during the previous 5-year period, while in the other regions only about 30 percent of the total were new entrants. These entrant-exit data show that the small net changes in farm numbers actually result from large gross movements into and out of the industry.

Of the farm operators who were in the industry in both 1971 and 1976, those who increased the output of their farms in real terms were the most common. At the national level, about 40 percent moved to a larger farm size, 32 percent to a smaller farm size, and 28 percent stayed the same. In Quebec and the Atlantic Provinces, however, farm operators who moved to a lower economic class were the most numerous.

Regional differences in direction and rates of change among economic classes and in entry-exit ratios are reflected in the relative rates of change in farm sales and capital accumulation over time. Average values of sales and capital per farm by region, measured in constant dollars, are in Table 6. The real value of sales and capital per farm increased substantially from 1966 to 1976 in all regions, although there was a considerable amount of variation between regions and periods. In the Prairie region, average sales increased 32 percent from 1966 to 1971 and 46 percent from 1971 to 1976. In contrast, average sales in the Atlantic region increased 83 percent between 1966 and 1971 and 32 percent between 1971 and 1976. The average value of sales for Canadian farms in 1976 was 87 percent higher than in 1966.

While the average value of capital per farm also increased during the period, this increase bore little relationship to the rise in farm sales. For example, average sales in Quebec increased 42 percent during the 1966-76 period but average capital value climbed 119 percent. Average capital values also rose faster than average sales in the Atlantic region, but in British Columbia, the Prairies, and Ontario, the percent increases in average sales were relatively greater than the increases in capital values.

At the national level the average value of capital increased 70 percent in real terms between 1966 and 1976. With the exception of British Columbia, the rates of change in average capital values were greater in 1971-76 than in the earlier 1966-71 period.

TABLE 8. VALUE OF FARM SALES PER $1000 OF CAPITAL BY ECONOMIC CLASS, CANADA

Constant 1975 Dollar Economic Classes	Value of Farm Sales per $1000 of Capital 1966	1971	1976
		constant 1975 dollars	
Less than 1 200	13	9	14
1 200 - 2 499	47	35	25
2 500 - 14 999	110	97	75
15 000 - 49 999	164	169	152
50 000 and over	319	323	304
Total	161	179	176

TABLE 9. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR, CANADA, 1971-76

Structural Change	Movement of Operator: Decreasing Farm Size	Stable Farm Size	Increasing Farm Size
Change in owned land (acres)[a]	−37.0	19.6	84.9
Change in rented land (acres)[a]	−31.6	0.8	14.7
Change in off-farm work (days)[b]	3.0	−8.0	−21.0

[a] Average change in acres per farm.
[b] Average change in days of off-farm work per operator.

Comparing the distribution of farm sales (Table 7) with the distribution of farms (Table 4), one can see the changing relative importance of large and small farms in terms of output. In 1966 the $2500-$14 999 sales class accounted for 53 percent of the farms and 22 percent of total sales. By 1976 this class had 40 percent of the farms and only 9 percent of the sales. The proportion of farms in the largest class increased from 6 to 15 percent during the same period, while the proportion of sales accounted for by this class increased from 32 to 59 percent.

Table 7 also presents a comparison of the distribution of sales over time with the distribution of resources. Again, when comparing the smallest commercial class ($2500-$14 999) to the largest class ($50 000 and over), the decline in resource use has been less than proportionate to the decline in sales of the smaller class, while the increase in sales of the larger class has outpaced the increase in resource use. In 1976 the $2500-$14 999 sales class used 22 percent of the total capital, 22 percent of the improved land, and 10 percent of the hired labor to produce 9 percent of the total sales. By comparison, the $50 000 and over sales class produced 59 percent of the total sales with 34 percent of the total capital, 31 percent of the improved land, and 65 percent of the hired labor. These estimates imply a greater degree of resource efficiency on the larger farms.

This evidence of greater resource efficiency on larger farms is supported by the data in Table 8 which indicate the value of farm sales per $1000 of capital by economic class. In each census year, sales per $1000 of capital increase dramatically with farm size. In 1976, farms in the $2500-$14 999 class averaged $75 in sales per $1000 of capital, compared with $304 in sales per $1000 of capital for farms with sales of $50 000 and more.

The data in Table 8 also indicate that average sales for each $1000 of capital were lowest in 1976 for all economic classes except the 'less than $1200' class. However, when all classes are combined, the sales-capital ratio was higher in 1976 than in 1966. This is explained by the increasing proportion of farms in the higher economic classes where the value of sales per $1000 of capital is greater.

Farm operators were fairly evenly distributed among farms of decreasing, stable, and increasing farm size (Table 5). Just as structural characteristics vary by region and economic class, many structural changes are related to the movement of operators among economic classes. For example, operators who reduce their farm size with the intention of leaving the industry will act differently from those wishing to expand their operations. Evidence of this can be seen in Table 9.

On the average, operators who moved to a lower economic class between 1971 and 1976 reduced their acres of owned and rented land while increasing their days of off-farm work. Conversely, operators who increased their farm size tended to increase their land holdings and reduce their days of off-farm work. The average change in acres owned and rented was smallest on farms of stable size, with the operators also reducing their days of off-farm work but by less than the operators of expanding farms.

SUMMARY

This report outlines a study which attempted to measure real structural change in the Canadian farm industry by removing the distorting influences of product and resource price fluctuations. The report describes the methodology used, presents the results in tabular form, and highlights some of the findings. This material could provide a new perspective for more in-depth analysis of structural change.

The constant dollar values used in this study present a much more moderate picture of farm industry structural change than that obtained using nominal value observations. Nevertheless, there have been significant increases in the real value of sales and capital per farm during the 1966-76 period. The results indicate that a small number of large farms account for most of the total value of output and that this concentration has increased over time. These large farms were found to be more efficient in resource use as measured by the share of sales relative to the share of resources used and by sales-capital ratios.

The net decrease in farm numbers over time was shown to be the result of large gross movements into and out of the industry. Moreover, existing farm operators were shown to be fairly evenly distributed into groups of increasing, decreasing, or stable farm size, each with distinct structural characteristics.

The study indicates the value of examining structural change in real terms and the dangers of using aggregate data for structural change analysis. As inflation continues, the gap between real and nominal values widens and comparisons in current dollar or nominal terms become less meaningful. Observed differences in structural characteristics among provinces, economic classes, and phase of operation (entry, exit, and increasing, decreasing, and stable farm size) suggest that analysis of data, not disaggregated into these components, could erroneously identify structural characteristics that are really a mixture of different, and often opposite, structural changes.

APPENDIX

TABLE 1. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, BRITISH COLUMBIA

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	6525	2200	2280	2405	1270	1710	940	680	700	350	19 055
1971	5815	2250	2230	2140	1140	1390	800	790	1130	680	18 365
1976	6400	2985	2370	2045	1165	1130	630	625	1115	935	19 395
Farm sales (million 1975 $)											
1966	2	4	8	17	15	33	27	28	46	70	251
1971	3	4	8	15	14	27	24	33	77	147	352
1976	5	6	9	15	15	23	19	26	81	215	413
Value of land and buildings (million 1976 $)											
1966	398	162	205	258	180	278	183	154	228	187	2 233
1971	475	212	248	272	178	259	180	205	390	505	2 919
1976	547	318	284	287	187	211	139	150	351	548	3 023
Value of machinery and equipment (million 1976 $)											
1966	28	14	20	26	18	28	18	16	21	16	205
1971	29	15	20	25	17	24	16	19	35	35	237
1976	40	31	31	34	25	29	21	21	46	67	345
Value of livestock and poultry (million 1976 $)											
1966	7	6	11	17	11	19	12	12	19	27	141
1971	9	6	9	11	10	15	11	14	27	41	154
1976	6	10	12	16	13	18	11	14	34	56	191
Improved land (thousand acres)											
1966	154	83	153	223	175	234	141	113	167	161	1 605
1971	147	94	147	234	160	241	132	130	222	237	1 744
1976	92	162	179	237	192	222	155	136	243	273	1 888
Hired labor (thousand weeks)											
1966	9	6	14	26	22	38	29	32	64	128	369
1971	7	5	9	14	13	22	20	24	55	135	303
1976	6	7	11	16	15	22	16	22	55	159	329

Notes: The economic class limits for 1966 and 1971 were adjusted to reflect constant 1975 dollars, consistent with what was reported in the 1976 census. Thus, the distributions by economic class over time are presented in real terms. All monetary values are expressed in real terms. Farm sales data are adjusted to constant 1975 values while capital value data are adjusted to constant 1976 values, as per the 1976 census. Weeks of hired farm labor in 1966 were estimated using the cash wages reported in the census and estimates of the weekly wage rate of hired farm labor.

Source: Unpublished Statistics Canada data.

TABLE 2. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, ALBERTA[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	6930	4390	8440	13 635	9935	12 080	5630	3855	3150	1200	69 250
1971	6030	3665	5970	10 055	7895	10 955	6045	4850	4675	2385	62 525
1976	3820	5240	7500	9 890	7220	8 635	5630	4595	5730	2695	60 955
Farm sales (million 1975 $)											
1966	3	8	31	99	121	231	163	157	208	268	1 291
1971	2	7	22	75	98	215	179	202	319	606	1 723
1976	3	10	28	74	90	173	169	195	402	865	2 009
Value of land and buildings (million 1976 $)											
1966	183	129	335	741	740	1 218	786	688	888	521	6 133
1971	219	140	286	620	620	1 136	806	817	1102	1116	6 859
1976	233	358	564	916	869	1 326	1132	1131	2007	1984	10 524
Value of machinery and equipment (million 1976 $)											
1966	30	26	72	167	166	275	175	149	159	90	1 309
1971	29	22	50	118	125	226	162	160	200	174	1 265
1976	23	56	94	172	173	280	250	251	434	373	2 107
Value of livestock and poultry (million 1976 $)											
1966	10	12	42	102	103	162	97	86	103	101	817
1971	9	8	21	60	69	136	103	108	153	200	866
1976	3	26	49	93	97	149	120	117	192	273	1 120
Improved land (thousand acres)											
1966	635	552	1578	3 591	3453	5 620	3580	3048	3285	1849	27 191
1971	611	488	1168	2 815	2939	5 201	3659	3575	4334	3578	28 364
1976	166	758	1336	2 560	2659	4 085	3494	3434	5794	4915	29 195
Hired labor (thousand weeks)											
1966	5	4	14	36	40	81	71	82	135	155	624
1971	5	2	6	18	16	37	33	47	104	271	539
1976	2	6	10	18	18	31	32	39	96	290	543

[1] See Table 1 for notes and source.

TABLE 3. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, SASKATCHEWAN[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	3265	2840	7920	16 570	14 610	20 295	10 185	5990	3 245	515	85 430
1971	2575	2410	6425	14 145	12 660	17 800	9 330	6125	4 165	1065	76 705
1976	1380	3035	5365	9 585	9 495	13 745	9 990	8310	8 070	1695	70 675
Farm sales (million 1975 $)											
1966	1	5	30	124	181	394	298	245	209	105	1 591
1971	1	5	24	106	157	348	274	253	274	221	1 664
1976	1	6	20	72	119	275	300	353	555	788	2 703
Value of land and buildings (million 1976 $)											
1966	64	59	252	773	962	1 854	1 304	990	771	193	7 222
1971	76	71	270	911	1 118	2 103	1 439	1193	1 072	433	8 686
1976	43	123	243	560	750	1 454	1 439	1520	2 127	896	9 154
Value of machinery and equipment (million 1976 $)											
1966	11	12	54	175	288	454	316	237	172	39	1 700
1971	9	10	42	149	191	372	256	215	185	67	1 496
1976	7	30	60	143	203	413	419	450	623	223	2 571
Value of livestock and poultry (million 1976 $)											
1966	4	5	23	71	83	143	92	64	55	26	564
1971	3	2	11	45	66	136	105	88	96	59	612
1976	1	17	29	67	84	150	129	124	150	76	827
Improved land (thousand acres)											
1966	364	372	1690	5 133	6 165	11 699	8 015	6057	4 545	1039	45 073
1971	337	355	1444	4 915	6 059	11 420	7 778	6371	5 445	1878	45 991
1976	82	613	1274	3 099	4 110	7 829	7 475	7643	10 298	3807	46 231
Hired labor (thousand weeks)											
1966	2	2	11	34	45	104	92	93	109	51	544
1971	1	1	6	16	24	55	50	59	78	92	381
1976	1	3	5	11	16	36	42	50	99	146	409

[1]See Table 1 for notes and source.

TABLE 4. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, MANITOBA[1]

Variable	Economic Class Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	4025	2520	5295	8290	6270	7225	3095	1635	1025	325	39 710
1971	3190	2035	3760	6460	5030	6530	3240	2210	1770	715	34 945
1976	2140	2645	3630	4910	3885	5280	3345	2530	2710	975	32 050
Farm sales (million 1975 $)											
1966	2	5	19	61	77	138	90	67	68	78	603
1971	1	4	14	48	62	127	95	92	119	179	741
1976	2	5	14	37	49	106	100	108	188	327	933
Value of land and buildings (million 1976 $)											
1966	68	46	129	322	358	568	329	213	177	93	2 302
1971	82	56	129	316	325	555	349	282	291	252	2 636
1976	64	95	148	265	272	494	406	393	587	461	3 185
Value of machinery and equipment (million 1976 $)											
1966	14	12	36	90	99	161	93	60	47	22	634
1971	13	11	28	71	74	132	83	69	68	49	600
1976	11	24	40	76	81	152	130	127	189	129	958
Value of livestock and poultry (million 1976 $)											
1966	6	6	25	52	46	63	32	20	18	20	288
1971	4	4	12	32	34	57	39	32	31	32	277
1976	2	13	23	40	40	62	45	38	51	52	364
Improved land (thousand acres)											
1966	274	244	792	1939	2057	3077	1710	1094	842	385	12 417
1971	247	223	625	1641	1722	2909	1788	1408	1318	887	12 746
1976	87	347	614	1210	1292	2227	1774	1612	2219	1427	12 810
Hired labor (thousand weeks)											
1966	2	2	8	19	22	46	39	34	44	47	264
1971	1	1	4	10	13	26	21	23	36	119	254
1976	1	2	3	7	11	19	18	19	44	148	274

[1] See Table 1 for notes and source.

TABLE 5. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, ONTARIO[1]

Variable	Economic Class: Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	17 230	9040	13 760	19 350	12 925	15 815	8210	5850	5665	1965	109 805
1971	14 110	7045	10 110	14 155	9 660	12 605	7770	7365	8335	3485	94 635
1976	11 815	9290	12 040	11 525	7 430	8 955	6560	6745	9840	4515	88 720
Farm sales (million 1975 $)											
1966	7	17	50	141	159	306	241	242	381	449	1 992
1971	6	13	37	103	120	247	230	307	573	773	2 407
1976	9	17	45	86	93	179	197	287	695	1046	2 655
Value of land and buildings (million 1976 $)											
1966	1 148	630	1 138	1 880	1 551	2 369	1606	1462	1875	1099	14 757
1971	959	496	777	1 263	970	1 492	1133	1363	2181	1838	12 471
1976	791	745	1 116	1 279	964	1 326	1127	1365	2696	2353	13 763
Value of machinery and equipment (million 1976 $)											
1966	71	47	95	173	151	240	160	136	159	82	1 315
1971	64	40	71	126	106	179	143	166	244	159	1 299
1976	69	79	127	154	127	190	180	228	443	338	1 936
Value of livestock and poultry (million 1976 $)											
1966	35	32	81	161	143	218	135	100	101	91	1 097
1971	36	27	58	110	97	161	121	127	158	101	1 048
1976	12	39	72	99	83	126	119	146	262	251	1 208
Improved land (thousand acres)											
1966	804	554	1 099	1 933	1 543	2 190	1304	1004	1017	526	11 975
1971	612	387	711	1 273	1 075	1 682	1222	1273	1629	973	10 838
1976	361	577	932	1 126	872	1 234	1059	1229	2125	1530	11 045
Hired labor (thousand weeks)											
1966	15	13	34	78	80	170	183	262	543	548	1 926
1971	19	9	21	48	114	97	91	150	374	566	1 488
1976	10	16	30	45	38	66	75	110	313	555	1 258

[1] See Table 1 for notes and source.

TABLE 6. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, QUEBEC[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	13 935	7985	13 985	19 455	10 220	8350	2895	1655	1185	490	80 145
1971	8 875	4605	6 670	11 285	8 540	9830	4830	3100	2490	935	61 155
1976	8 490	5750	5 185	6 255	5 270	7440	5265	3905	3000	950	51 510
Farm sales (million 1975 $)											
1966	6	15	52	141	125	159	85	68	80	104	834
1971	4	8	25	83	105	191	142	128	164	214	1 064
1976	7	11	19	47	66	149	158	166	206	405	1 230
Value of land and buildings (million 1976 $)											
1966	275	172	364	624	414	415	181	121	98	67	2 730
1971	214	127	197	384	342	473	287	220	223	166	2 633
1976	216	205	207	263	248	391	333	310	326	191	2 692
Value of machinery and equipment (million 1976 $)											
1966	47	35	82	153	107	110	47	30	23	10	645
1971	30	21	39	88	87	130	81	62	59	26	622
1976	41	48	54	78	82	141	128	120	120	47	859
Value of livestock and poultry (million 1976 $)											
1966	22	22	68	138	99	101	44	28	25	23	569
1971	18	15	32	82	82	119	74	55	52	43	573
1976	11	26	33	54	61	103	91	84	84	69	615
Improved land (thousand acres)											
1966	760	530	1 165	1 956	1 193	1089	422	250	170	60	7 596
1971	506	311	531	1 097	972	1261	705	493	415	138	6 426
1976	374	449	472	649	618	1011	830	689	624	186	5 904
Hired labor (thousand weeks)											
1966	16	11	33	66	57	78	47	47	69	70	493
1971	7	7	13	37	38	70	54	51	75	108	460
1976	6	11	18	27	30	59	57	63	92	148	514

[1] See Table 1 for notes and source.

TABLE 7. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, NEW BRUNSWICK[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	3 265	1 330	1 350	1 085	520	505	230	170	165	70	8 690
1971	1 475	735	815	785	385	460	240	210	245	115	5 470
1976	1 305	740	595	500	260	310	205	195	270	145	4 535
Farm sales (thousand 1975 $)											
1966	1 450	2 275	4 597	7 378	6 168	9 178	6 567	7 059	10 738	14 524	69 676
1971	686	1 306	2 906	5 613	4 783	8 951	7 029	9 038	16 744	23 086	80 977
1976	1 044	1 369	2 231	3 750	3 250	6 200	6 150	8 288	19 375	37 939	89 350
Value of land and buildings (thousand 1976 $)											
1966	50 177	22 457	28 656	31 385	19 797	22 770	13 532	12 649	15 608	13 563	230 202
1971	25 201	14 177	18 865	24 033	14 851	20 162	14 455	12 770	23 450	18 017	186 094
1976	34 477	24 381	22 276	21 998	14 221	19 089	15 404	15 662	31 912	28 260	227 604
Value of machinery and equipment (thousand 1976 $)											
1966	9 470	5 400	7 850	9 215	6 279	7 148	4 357	4 109	5 489	4 484	63 675
1971	5 492	3 829	5 517	7 349	4 436	7 057	5 092	5 211	8 394	6 534	58 802
1976	7 926	6 870	6 970	6 860	4 729	7 447	6 231	7 113	14 689	11 082	79 880
Value of livestock and poultry (thousand 1976 $)											
1966	4 580	3 590	5 883	6 714	4 045	4 220	2 018	1 785	1 963	1 301	36 187
1971	2 571	2 590	3 670	5 102	3 159	4 322	2 214	2 173	3 656	3 480	32 953
1976	2 418	3 656	3 681	3 920	2 389	3 395	2 368	2 758	4 931	4 865	34 518
Improved land (thousand acres)											
1966	117	70	93	103	59	64	34	28	35	31	634
1971	53	40	55	69	44	58	37	34	58	35	481
1976	42	52	52	50	36	45	35	37	64	49	459
Hired labor (thousand weeks)											
1966	2	2	4	9	9	17	14	16	26	32	129
1971	1	1	2	5	5	10	8	8	18	29	86
1976	1	2	2	3	3	6	6	7	17	29	75

[1] See Table 1 for notes and source.

TABLE 8. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, NOVA SCOTIA[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	4 005	1 495	1 290	1 110	490	555	240	170	150	90	9 595
1971	1 795	915	855	735	365	405	245	240	260	170	5 990
1976	1 995	905	620	480	240	250	180	190	320	240	5 415
Farm sales (thousand 1975 $)											
1966	1 966	2 638	4 612	7 954	5 990	10 676	6 939	6 956	10 672	24 896	82 988
1971	894	1 644	3 038	5 260	4 429	7 946	7 301	9 959	18 065	41 260	99 573
1976	1 592	1 674	2 325	3 600	3 063	5 000	5 400	8 075	22 001	51 515	104 253
Value of land and buildings (thousand 1976 $)											
1966	50 328	22 782	25 264	27 313	16 133	23 116	12 501	11 254	13 078	14 619	215 973
1971	32 749	18 452	21 419	22 474	13 930	19 745	14 482	19 795	28 120	33 901	225 132
1976	55 972	33 618	28 850	27 282	16 741	19 444	16 859	18 764	41 440	57 689	316 782
Value of machinery and equipment (thousand 1976 $)											
1966	10 614	5 801	7 805	8 646	5 155	7 590	3 825	3 145	3 552	2 866	58 894
1971	6 448	4 565	5 089	6 256	3 987	5 932	4 313	5 618	8 001	7 535	57 795
1976	10 887	8 053	6 451	6 115	4 150	5 033	4 190	5 394	11 921	13 975	76 206
Value of livestock and poultry (thousand 1976 $)											
1966	5 379	3 649	5 004	6 059	3 913	5 335	3 155	2 503	3 168	4 640	42 854
1971	3 003	2 734	3 480	4 424	3 058	4 348	3 529	4 061	6 083	8 381	43 089
1976	3 037	4 052	3 403	3 905	2 590	2 968	2 852	3 980	9 006	12 793	48 559
Improved land (thousand acres)											
1966	98	55	66	72	42	55	29	22	24	18	480
1971	41	32	39	47	30	41	31	34	52	35	381
1976	51	48	40	40	26	26	23	28	57	70	412
Hired labor (thousand weeks)											
1966	2	2	4	7	6	13	9	10	17	34	103
1971	2	3	3	5	4	8	8	10	19	48	111
1976	2	2	2	4	4	4	6	7	20	50	99

[1] See Table 1 for notes and source.

TABLE 9. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, PRINCE EDWARD ISLAND[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	1 290	775	1 095	1 430	710	560	220	85	135	45	6 345
1971	745	475	695	880	515	555	210	180	180	95	4 535
1976	620	520	515	545	360	370	195	170	230	150	3 670
Farm sales (thousand 1975 $)											
1966	612	1 320	3 734	9 667	8 144	10 049	5 954	2 959	7 615	7 576	58 118
1971	359	872	2 588	6 451	6 286	10 708	6 184	7 742	12 299	17 278	69 672
1976	496	962	1 913	4 088	4 500	7 400	6 000	7 225	16 751	81 902	84 296
Value of land and buildings (thousand 1976 $)											
1966	17 103	11 781	20 792	35 710	23 479	22 428	11 471	4 528	9 736	7 870	165 258
1971	15 484	9 846	18 137	28 772	21 742	27 869	14 894	15 998	20 455	19 906	193 867
1976	15 638	16 319	19 001	24 012	19 287	24 685	16 169	15 393	29 852	38 002	217 110
Value of machinery and equipment (thousand 1976 $)											
1966	3 530	3 234	6 877	13 379	9 500	9 781	5 004	2 152	4 757	3 144	61 553
1971	2 450	2 063	4 269	8 082	6 196	8 770	4 437	5 009	7 004	7 016	55 355
1976	2 683	4 014	5 332	7 274	6 095	8 665	6 172	6 644	12 394	16 139	74 871
Value of livestock and poultry (thousand 1976 $)											
1966	1 572	1 895	4 200	8 199	5 397	5 239	2 376	1 065	2 116	921	32 975
1971	1 124	1 167	2 774	4 940	3 935	5 119	2 327	2 066	2 336	1 619	27 441
1976	865	2 080	2 853	4 572	3 537	4 662	2 912	2 940	4 597	4 220	33 079
Improved land (thousand acres)											
1966	53	42	78	133	83	77	36	15	28	23	568
1971	33	25	50	80	60	78	36	37	48	43	490
1976	24	38	46	60	46	58	40	38	66	84	498
Hired labor (thousand weeks)											
1966	1	1	3	7	6	10	7	4	10	11	60
1971	1	1	2	5	4	7	5	8	13	20	66
1976	1	1	1	3	3	4	3	5	14	34	71

[1] See Table 1 for notes and source.

TABLE 10. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, NEWFOUNDLAND[1]

	Economic Class										
Variable	Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	1 100	175	125	100	50	60	20	20	30	25	1 705
1971	535	110	95	75	35	40	30	25	45	25	1 020
1976	480	95	55	55	30	25	10	15	35	40	850
Farm sales (thousand 1975 $)											
1966	406	261	386	607	510	1021	535	926	2 032	5 056	11 972
1971	210	174	306	479	387	682	655	933	2 699	7 056	13 883
1976	384	176	206	413	375	600	450	638	2 876	12 438	18 484
Value of land and buildings (thousand 1976 $)											
1966	19 487	5665	5289	4292	2136	3977	1907	4003	3 658	5 590	55 792
1971	8 222	3002	3606	3206	3399	2773	2095	2572	4 727	5 949	39 739
1976	10 639	3528	2369	2502	2003	4231	1397	4818	9 506	10 981	51 147
Value of machinery and equipment (thousand 1976 $)											
1966	1 439	596	563	671	389	490	165	358	516	547	5 704
1971	1 064	318	378	686	383	497	343	286	524	1 095	5 630
1976	1 587	690	437	687	385	676	272	409	937	905	6 873
Value of livestock and poultry (thousand 1976 $)											
1966	1 084	253	305	298	197	530	144	197	433	1 342	4 661
1971	563	235	231	242	162	219	267	274	791	1 600	4 632
1976	480	272	144	168	155	170	79	176	664	1 813	4 296
Improved land (acres)											
1966	6 252	2245	2298	1794	847	1587	621	1593	1 780	861	19 851
1971	2 948	1174	1505	2005	1541	1319	1029	1095	15 813	1 238	15 342
1976	3 418	1646	1632	1792	1296	1674	518	960	2 789	1 249	16 853
Hired labor (weeks)											
1966	388	117	355	885	771	1617	792	1143	3 777	8 775	19 142
1971	128	270	370	373	411	1025	1101	1338	2 410	7 158	14 753
1976	720	308	250	437	430	664	621	442	2 052	6 470	13 184

[1] See Table 1 for notes and source.

TABLE 11. SELECTED STRUCTURAL VARIABLES BY CONSTANT (1975) DOLLAR ECONOMIC CLASS, 1966, 1971, AND 1976, CANADA[1]

Variable	Economic Class: Less than $1200	$1200 $2499	$2500 $4999	$5000 $9999	$10 000 $14 999	$15 000 $24 999	$25 000 $34 999	$35 000 $49 999	$50 000 $99 999	$100 000 and Over	Total
Farm numbers											
1966	61 575	32 735	55 550	83 430	56 995	67 155	31 665	20 105	15 455	5 075	429 730
1971	45 150	24 260	37 630	60 710	46 215	60 575	32 730	25 100	23 300	9 665	365 335
1976	38 455	31 215	37 870	45 785	35 365	46 130	32 025	27 285	31 305	12 350	337 785
Farm sales (million 1975 $)											
1966	27	60	204	603	691	1 277	917	823	1 035	1 153	6 792
1971	20	46	141	443	558	1 149	945	1 038	1 608	2 297	8 244
1976	31	58	142	343	442	923	961	1 160	2 186	3 737	9 982
Value of land and buildings (million 1976 $)											
1966	1 807	1 026	2 156	4 270	4 028	6 498	4 225	3 406	3 504	1 869	32 788
1971	2 058	1 129	1 947	3 826	3 607	6 093	4 229	4 095	5 255	4 357	36 594
1976	2 012	1 922	2 635	3 645	3 343	5 270	4 626	4 923	8 204	6 573	43 154
Value of machinery and equipment (million 1976 $)											
1966	222	158	373	805	783	1 282	817	632	589	267	5 931
1971	189	129	263	597	614	1 082	752	705	812	529	5 673
1976	213	287	426	677	706	1 228	1 145	1 216	1 895	1 220	9 014
Value of livestock and poultry (million 1976 $)											
1966	92	90	260	446	496	719	419	318	331	297	3 576
1971	83	67	148	351	369	647	471	441	544	560	3 683
1976	42	141	227	382	386	620	523	533	792	802	4 446
Improved land (thousand acres)											
1966	3 226	2 503	6 717	15 085	14 769	24 108	15 274	11 635	10 116	4 083	107 558
1971	2 589	1 953	4 772	12 173	13 061	22 888	15 390	13 350	13 519	7 780	107 477
1976	1 283	3 046	4 949	9 032	9 852	16 741	14 889	14 846	21 490	12 332	108 459
Hired labor (thousand weeks)											
1966	53	44	125	283	289	558	492	582	1 019	1 086	4 531
1971	42	30	66	159	231	334	291	382	774	1 394	3 703
1976	29	52	84	137	139	248	257	323	754	1 564	3 586

[1] Data for institutional farms and farms of the Northwest Territories and the Yukon are excluded.

See Table 1 for notes and source.

TABLE 12. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, BRITISH COLUMBIA

Operator Movement	Structural Change				
	Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	(rented land)	Average Change in Days of Off-Farm Work Per Farm
Entry					
1966-71	8040	41	–	–	–
1971-76	9780	39	–	–	–
Increasing farm size					
1966-71	4815	46	33.4	6.9	−27.5
1971-76	3670	45	31.3	33.5	−32.4
Decreasing farm size					
1966-71	2445	50	−83.0	−37.2	6.9
1971-76	2810	52	−74.7	−50.9	−3.5
Stable farm size					
1966-71	3075	49	26.0	59.8	−12.9
1971-76	3125	49	−31.0	55.7	−17.6
Exit					
1966-71	8735	52	–	–	–
1971-76	8755	51	–	–	–

Notes: A farm entrant was defined as a farm operator who was present at the end, but not at the beginning, of a period. A farm exit was the reverse. An established operator who was in a higher economic class in real terms, at the end of a period than at the beginning, was considered to have increased his farm size. An established farm operator who was in a lower economic class at the end of a period than at the beginning was considered to have decreased his farm size. If an established operator was in the same economic class at the beginning and end of a period he was considered to have had a stable farm size. Average age of operator refers to the operator's age at the beginning of the period, that is, the average age in 1966 for the 1966-71 period and in 1971 for the 1971-76 period.

Source: Unpublished Statistics Canada data.

TABLE 13. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, ALBERTA[1]

Operator Movement	Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
	Structural Change				
Entry					
1966-71	14 060	38	–	–	–
1971-76	19 010	35	–	–	–
Increasing farm size					
1966-71	23 250	44	108.0	57.6	−7.5
1971-76	16 690	43	131.7	29.2	−23.4
Decreasing farm size					
1966-71	11 710	49	−89.3	−144.5	15.3
1971-76	14 255	48	−204.1	−60.7	4.5
Stable farm size					
1966-71	13 500	47	63.4	25.0	2.4
1971-76	11 030	46	47.2	−6.2	−5.8
Exit					
1966-71	20 790	51	–	–	–
1971-76	20 570	52	–	–	–

[1] See Table 12 for notes and source.

TABLE 14. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, SASKATCHEWAN[1]

Operator Movement	Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
	Structural Change				
Entry					
1966-71	15 355	37	–	–	–
1971-76	17 310	31	–	–	–
Increasing farm size					
1966-71	23 130	42	143.1	46.2	−7.8
1971-76	26 530	43	154.8	2.2	−19.4
Decreasing farm size					
1966-71	19 050	49	−18.1	−39.7	5.4
1971-76	13 500	50	−51.6	−71.8	0.9
Stable farm size					
1966-71	19 180	43	71.3	−7.1	0.3
1971-76	13 310	47	41.3	−39.1	−5.7
Exit					
1966-71	24 085	53	–	–	–
1971-76	23 340	54	–	–	–

[1] See Table 12 for notes and source.

TABLE 15. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, MANITOBA[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	6 350	37	–	–	–
1971-76	8 565	33	–	–	–
Increasing farm size					
1966-71	12 220	44	80.1	47.8	−5.3
1971-76	9 555	43	96.8	19.5	−22.3
Decreasing farm size					
1966-71	7 625	50	−38.0	−15.3	17.4
1971-76	7 385	49	−40.6	−28.6	3.6
Stable farm size					
1966-71	8 785	48	34.4	6.5	5.0
1971-76	6 525	47	26.7	−19.3	7.3
Exit					
1966-71	11 115	52	–	–	–
1971-76	11 455	53	–	–	–

[1] See Table 12 for notes and source.

TABLE 16. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, ONTARIO[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	27 960	39	–	–	–
1971-76	28 630	38	–	–	–
Increasing farm size					
1966-71	28 965	44	12.3	13.9	−12
1971-76	22 475	41	16.2	18.4	−23
Decreasing farm size					
1966-71	17 075	51	−19.4	−4.9	16
1971-76	19 355	50	−16.6	−4.8	0
Stable farm size					
1966-71	20 675	48	0.5	1.7	−1
1971-76	18 270	48	−0.3	3.9	−11
Exit					
1966-71	43 125	54	–	–	–
1971-76	34 550	53	–	–	–

[1] See Table 12 for notes and source.

TABLE 17. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, QUEBEC[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	(rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	12 135	39	–	–	–
1971-76	14 200	36	–	–	–
Increasing farm size					
1966-71	23 685	43	20.8	6.1	−18
1971-76	13 235	42	32.1	6.6	−16
Decreasing farm size					
1966-71	11 245	48	−10.2	−3.6	6
1971-76	13 275	47	−6.9	−1.9	9
Stable farm size					
1966-71	14 100	47	4.0	−0.7	−5
1971-76	10 795	45	10.7	2.0	−6
Exit					
1966-71	31 130	51	–	–	–
1971-76	23 845	52	–	–	–

[1] See Table 12 for notes and source.

TABLE 18. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, NEW BRUNSWICK[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	(rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	1235	42	–	–	–
1971-76	1500	39	–	–	–
Increasing farm size					
1966-71	1605	47	27.4	12.8	−12
1971-76	845	46	54.4	5.2	−22
Decreasing farm size					
1966-71	1210	51	−11.6	−3.4	13
1971-76	1265	50	−15.0	−6.5	6
Stable farm size					
1966-71	1410	50	2.0	2.1	−3
1971-76	915	45	3.3	−2.4	−14
Exit					
1966-71	4455	54	–	–	–
1971-76	2430	54	–	–	–

[1] See Table 12 for notes and source.

TABLE 19. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, NOVA SCOTIA[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	1550	42	–	–	–
1971-76	2130	41	–	–	–
Increasing farm size					
1966-71	1695	48	21.2	22.0	−14
1971-76	905	46	54.1	3.6	−20
Decreasing farm size					
1966-71	1185	52	−21.9	−0.9	16
1971-76	1265	52	−23.7	−8.5	3
Stable farm size					
1966-71	1575	52	−4.4	5.7	−9
1971-76	1115	50	17.0	−2.7	−2
Exit					
1966-71	5155	56	–	–	–
1971-76	2700	55	–	–	–

[1] See Table 12 for notes and source.

TABLE 20. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, PRINCE EDWARD ISLAND[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	785	37	–	–	–
1971-76	800	37	–	–	–
Increasing farm size					
1966-71	1240	44	29.2	13.9	−12
1971-76	860	45	26.5	31.4	−11
Decreasing farm size					
1966-71	1185	50	−17.8	−3.2	16
1971-76	1125	46	−14.9	−0.2	13
Stable farm size					
1966-71	1305	49	10.3	6.3	1
1971-76	865	43	8.1	12.3	−5
Exit					
1966-71	2595	54	–	–	–
1971-76	1670	54	–	–	–

[1] See Table 12 for notes and source.

TABLE 21. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, NEWFOUNDLAND[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	480	43	–	–	–
1971-76	440	42	–	–	–
Increasing farm size					
1966-71	135	48	13.3	−2.5	−28
1971-76	85	45	5.8	3.8	−46
Decreasing farm size					
1966-71	120	50	12.5	3.8	3
1971-76	120	49	0.6	4.5	2
Stable farm size					
1966-71	275	50	2.4	−0.4	−18
1971-76	180	48	−0.4	0.2	−5
Exit					
1966-71	1165	51	–	–	–
1971-76	610	52	–	–	–

[1] See Table 12 for notes and source.

TABLE 22. SELECTED STRUCTURAL CHANGES BY MOVEMENT OF FARM OPERATOR AMONG CONSTANT (1975) DOLLAR ECONOMIC CLASSES, 1966-71 AND 1971-76, CANADA[1]

Operator Movement	Structural Change: Farm Numbers	Average Age of Operator	Tenure: Average Change in Acres per Farm (owned land)	Tenure: Average Change in Acres per Farm (rented land)	Average Change in Days of Off-Farm Work per Farm
Entry					
1966-71	87 955	39	–	–	–
1971-76	102 370	36	–	–	–
Increasing farm size					
1966-71	120 710	44	62.5	34.9	−12
1971-76	94 880	43	84.9	14.7	−21
Decreasing farm size					
1966-71	72 755	49	−25.0	−18.9	12
1971-76	74 345	49	−37.0	−31.6	3
Stable farm size					
1966-71	83 875	48	28.1	5.9	−1
1971-76	66 140	47	19.6	−6.8	−8
Exit					
1966-71	152 355	53	–	–	–
1971-76	129 920	53	–	–	–

[1] Data for institutional farms and farms of the Northwest Territories and the Yukon are excluded.

See Table 12 for notes and source.

ECONOMIC INDICATORS

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978 III	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual	1980 I	1980 II
Production and Income											
1. GNP at Market Prices[a]	$ mil.	233,200[b]	237,968[b]	229,698[b]	247,496[b]	256,256[b]	264,712[b]	272,756[b]	260,305[b]	278,700[b]	281,384
2. Farm Cash Receipts Total[d]	$ mil.	2,900.3[b]	3,341.6[b]	11,899.0[b]	3,380.5[b]	3,255.0[b]	3,430.1[b]	3,904.8[b]	13,970.9[b]	3,799.5	3,451.9
3. – Total Crops[d]	$ mil.	1,161.0[b]	1,248.0[b]	4,906.1[b]	1,447.3[b]	1,188.3[b]	1,464.8[b]	1,764.5[b]	5,861.3[b]	1,829.4	1,349.1
4. – Total Livestock[d]	$ mil.	1,645.3[b]	1,923.7[b]	6,541.5[b]	1,861.1[b]	1,938.9[b]	1,872.3[b]	2,051.9[b]	7,724.1[b]	1,903.5	1,975.5
5. Net Income Rec'd by Farm Operators[a]	$ mil.	3,076.0[b]	3,240.0[b]	3,214.0[b]	3,988.0[b]	4,348.0[b]	3,280.0[b]	4,152.0[b]	3,942.0[b]	3,380.0[b]	2,648.0
Trade											
6. Agricultural Exports	$ mil.	1,261.3[b]	1,391.8[b]	4,846.3	1,204.4	1,354.7	1,663.9	1,884.8	6,107.8	1,501.5	2,008.2
7. Agricultural Imports	$ mil.	943.2	1,104.4	4,015.06	1,129.2	1,181.6	1,129.4	1,240.4	4,680.6	1,158.9	1,256.9
8. Real Domestic Product, Ag[a]	1971=100	117.5[b]	119.7[b]	117.8[b]	109.7[b]	104.9[b]	105.5[b]	112.4[b]	108.1[b]	111.5[b]	112.9
9. Real Dom. Prod. Less Ag[a]	1971=100	136.6[b]	138.3[b]	135.9[b]	138.3[b]	138.9[b]	140.8[b]	140.4[b]	139.6[b]	140.1[b]	138.8
Price Indexes											
10. Farm Input Price Index	1971=100	203.2	209.2	201.1[b]	229.0[b]	233.9[b]	235.6[b]	239.1[b]	234.4[b]	253.7	251.3
11. – Buildings and Fencing	1971=100	203.1	209.9	201.0	216.1	233.2	229.5	235.3	226.0	235.5	235.5
12. – Machinery & Motor Veh.	1971=100	176.0	182.1	176.2[b]	188.0	191.8[b]	196.2[b]	205.3	193.3	214.2	220.9
13. – Crop Production	1971=100	228.3	230.2	225.5	238.6	252.5[b]	258.5[b]	266.5	254.0	296.9	308.8
14. – Animal Production	1971=100	207.3	218.2	201.8	246.8	252.3[b]	249.2[b]	247.8	249.0	252.7	232.8
15. – Hired Farm Labor	1971=100	223.9	225.4	220.4	228.0	232.8	235.7	237.8	233.6	242.1	245.1
16. – Interest	1971=100	284.5	284.5	284.5	385.1[b]	385.1[b]	385.1[b]	385.1[b]	385.1[b]	474.7	481.6
17. Farm Prices of Ag. Prod.[d]	1971=100	209.9	221.9	217.6[b]	250.3[b]	250.7	247.7[f]	246.4[f]	298.8[f]	248.7[f]	242.5
Input and Credit											
18. Farm Impl. & Equip. Sales[e]	$ mil.	418.8	342.4	1,288.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in Agriculture[a]	'000	479.3	490.3	473.0	499.7[b]	497.7[b]	466.7[b]	475.3	484.9	498.0[b]	481.0
20. Av. Farm Labor Rates	$/hr.	3.78	3.84	3.76	3.89	3.95	4.01	4.08	3.98	4.15	4.22
21. Av. Hourly Earnings-Manf.	$/hr.	6.87	7.03	6.84[b]	7.19[b]	7.37[b]	7.50	7.68	7.44	7.90	8.05
22. F.C.C. – Gross Loan Disburs.	$ mil.	205.7	121.7	533.6	35.4	174.7	192.4	145.2	547.7	98.5	189.6
23. CPI – All Items	1971=100	177.7	180.5	175.2	184.6	189.4	193.1	197.6	191.2	202.0	207.6
24. – Food at Home	1971=100	218.7	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0	250.3	258.2
25. – Food Away from Home	1971=100	202.2	207.3	199.3	213.1	220.8	227.3	232.4	223.4	237.1	240.7
26. Industry Selling Price Index – Food & Beverage	1971=100	208.5[b]	214.3[b]	205.6[b]	225.9[b]	230.1[b]	233.3[b]	237.5[b]	231.7	244.0[b]	247.8

continued

MARKETING AND ECONOMICS BRANCH

QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1978			1979					1980	
		III	IV	Annual	I	II	III	IV	Annual	I	II
Other Indicators											
27. Unemployment Rate	%	8.5	8.2	8.4	7.9[b]	7.6[b]	7.1	7.3	7.5	7.4	7.6
28. Exchange Rate	$ U.S.	1.14	1.18	1.14	1.19	1.16	1.17	1.19	1.17	1.16	1.17
29. Av. Rate on New Demand Loans	%	10.03[b]	12.32	10.18	12.31	12.55	12.81	15.27	13.24	15.33	16.30
30. Quarterly Pop. Est.	mil.	23.50	23.55	23.48	23.60	23.65	23.69	23.74	23.67	23.81	23.87

[a] Seasonally adjusted at annual rates.

[b] Revised.

[c] Preliminary

[d] Excludes Newfoundland.

[e] Excluding repair parts.

[f] Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Marketing and Economics Branch; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

NOTES

MARKET INFORMATION SERVICE

This note was prepared for Canadian Farm Economics by I.W. Willsher, Chief, Market Information Service.

As a result of last summer's departmental reorganization, the Marketing and Economics Branch acquired the Marketing Services Division from the old Food and Agriculture Marketing Branch. An important component of this division is the Market Information Service.

The Market Information Service coordinates the national agricultural market's information collection, compilation, and dissemination system for daily, weekly, monthly, seasonal, and annual reports through various media. The section includes five commodity units – poultry, livestock, dairy products, fruit and vegetables, and grains and special crops – each headed by a market information specialist.

Information is gathered in two ways. One is by using regional Food Production and Inspection Branch staff to gather information from various industry discovery points. These discovery points include egg grading stations, plants and hatcheries, retail outlets, wholesalers, brokers, creameries, factories, processors, producers, marketing agencies or boards, wholesalers, terminals, packing plants, and stockyards. In most locations, district reporting centers coordinate and prepare regional summaries on each commodity. These are then transmitted to Ottawa. In some cases these summaries are only preliminary estimates. Raw data are then channeled to Ottawa through different media, not only to verify the summaries but to provide additional information for supplementary reports.

To ensure that this information is collected, an interbranch contract encompassing more than 130 pages of market information specifications is prepared on a yearly basis. This specifies regional and national information requirements by commodity, including content, frequency, deadlines, and communication medium.

Information is also gathered by Market Information Service staff. Depending upon the commodity, this direct contact can encompass marketing boards or agencies, packing plants, brokers, customs, transportation companies, foreign governments, other branches of Agriculture Canada, and other federal departments.

All phases of the information operations, whether they are regional summaries or compilation, processing, and distribution by headquarters, are geared to a specific timetable. Just to meet daily and weekly publication requirements at headquarters alone, more than 250 deadlines must be met each week of the year.

The compilation system which until the mid-1970s was primarily clerical, has gradually changed as more electronic systems have been applied. The service now operates seven major computer programs for dressed meat imports, dressed meat exports, stockyard volumes and prices, beef and land marketing origins, hog marketing origins, unloads of domestic and imported fruit and vegetables, and cheese imports.

Market Information Service has established a facsimile network at 28 centers across the country to transmit information both ways. Last year, more than 7200 special market information releases were distributed by facsimile to regional centers for redistribution to industry.

The service also provides a daily code-a-phone information service which dispenses current livestock volumes, prices, and trends. The code-a-phone service received more than 105 000 calls last year; the majority of calls were from producers.

Approximately 26 000 clients receive the service's published information. Before the 1970s, clients were primarily producers. However, because of economic uncertainty and a much improved information program throughout the 1970s, the service today supplies more segments of the total food industry than ever before. Clients are not only producers and processors but wholesalers, retailers, financial institutions, the transportation industry, research organizations, statisticians, consumers, and governments at the provincial, federal, and foreign levels. Since the published information is not generally publicized for industry usage, the majority of users have learned about the service on a word-of-mouth basis.

Since the 1980s will propel us further into the age of electronics, there is no question that marketing channels will be more geared to electronic marketing than ever before.

To keep abreast of this development the Market Information Service will attempt to convert its information collection, compilation, and dissemination system to an electronically compatible network that will allow it to tap electronic marketings. This in turn would allow users access to market information electronically.

CANADIAN-CHINESE AGRICULTURAL AGREEMENT

Agricultural cooperation between China and Canada took a major step forward recently with the signing of a memorandum of understanding between the two countries.

The memorandum, between Agriculture Canada and China's Ministries of Agriculture and State Farms and Land Reclamation, calls for intensified cooperation between the two countries in several areas, including joint projects, exchanges of information and materials, scientific visits, and commercial contacts.

The first activity to be carried out under the memorandum will be the visit to Canada of a Chinese delegation studying agricultural legislation.

This is the first such memorandum of understanding signed by a Canadian government department with its Chinese counterpart.

There will be annual consultations between the Canadian and Chinese agriculture departments to review the implementation of the agreement.

Several exchanges and projects may be carried out in 1980-81 in implementing the memorandum of understanding. These include joint research on rangeland management, a model ranch in northeast China, exchanges of plant and animal breeding materials, and an examination of the feasibility of work-study programs.

NEW CROP DEVELOPMENT FUND

Since its beginning in 1974, Agriculture Canada's New Crop Development Fund has committed about $4.3 million to assist more than 50 agricultural research projects across Canada.

The fund's objective is to stimulate the development of new crops and varieties, new growing areas for established crops, and new uses and production methods for these crops. The fund is designed to bridge the gap between basic research and commercial production.

Assistance under the fund is available to Canadian commercial companies, industrial and producer organizations, universities, and provincial government agencies. The fund operates on a cost-sharing basis.

To be eligible for funding, an organization must show adequate financial, physical, technical, and managerial capabilities to carry out its proposed project.

The focus is on the development of crops currently grown on a small scale, as well as on new crops that show potential for Canadian agriculture. Examples of crop research which have been aided by the fund are grapes in Quebec, Ontario, and British Columbia; triticale in Manitoba; peanuts in Ontario; and sorghum and saskatoon berries on the prairies.

The New Crop Development Fund projects also provide information to farmers about the results of this research. Field trials are encouraged, and tours, seminars, and workshops are often sponsored.

Applications for assistance are evaluated by a five-man approval board: chairman Yvan Jacques, Assistant Deputy Minister for Marketing and Economics, and two other members from Agriculture Canada; one member from the Department of Industry, Trade and Commerce; and one from the National Research Council.

Enquiries should be directed to:

New Crop Development Fund Secretariat
Agriculture Canada
Marketing Services Division
Room 6120
Sir John Carling Building
Ottawa, Ontario
K1A 0C5

A booklet, "New Crop Development Fund," is available on request.

HOG FUEL

Sometimes considered a nuisance, the farm manure pile could become a farm energy source.

According to G.E. Timbers of Agriculture Canada's Engineering and Statistical Research Institute in Ottawa, in 1979, waste from hog operations alone amounted to more than 21 million tons.

This can represent a big disposal problem for farmers because many of Canada's hog operations are near urban areas.

The technology for producing methane gas from manure has been known and used for more than a century. It is a biological process based on fermentation.

The manure is diluted, heated, and agitated in a tank called a digester. Under ideal conditions, bacteria ferment the waste, producing methane and other byproducts.

For the process to work at peak efficiency, the digester must be kept above 35°C – a problem here in Canada.

Agriculture Canada contracted with the University of Manitoba to study this temperature problem and to find out whether or not on-farm methane production is practical under Canadian conditions. The study also included an assessment of the impact of methane production on the environment and the use of the waste product as fertilizer.

The results of this study showed some promise and helped lay groundwork for further research. After gas production, the waste product still provided the necessary nitrogen and minerals for application as fertilizer. But pollution was significantly lower than when the manure itself was used as fertilizer.

Although the digesters functioned fairly well, about one-third of the methane produced was needed to maintain the temperature of the digester.

Contracts were awarded for the construction and operation of farm-scale digester systems on two hog farms. Gas production of 84 m^3 a day was typical at an operating temperature of 35°C in a 100 m^3 digester.

These results confirmed that there are many untapped energy sources available in agriculture, which can be used without reducing our food production.

There are still problems to be overcome before this technology can be widely recommended and applied. However, the environmental benefits must be considered with the straight gas economics of methane production to make such a program someday feasible on the farm.

PUBLICATIONS

On page 39 of the August 1980 issue of Canadian Farm Economics, *it is stated that four items relating to the 17th International Conference of Agricultural Economists at Banff, Alberta, in September 1979 are available from the International Association of Agricultural Economists, Oxford, England. This is incorrect.*

1. "Plenary and Invited Papers, 17th International Conference of Agricultural Economists" will be published (and sold) this winter as *Rural Change: The Challenge of Agricultural Economists* – Proceedings of the 17th International Conference, by Gower Publishing Co. Ltd., 1 Westmead, Farmborough, Hampshire, GU14 7RU, England, or from Allan Held, Osmun and Co., 6 South Fullerton Ave., Montclair, New Jersey, United States.

2. "Rural Change – Trends and Challenges in Canadian Agriculture" by J. Harold Hanna, is available from the Office of the Assistant Deputy Minister, Economics and Marketing Services, Alberta Agriculture, 9718-107 Street, Edmonton, Alta. T5K 2C8.

3. "Fifty Years of Agricultural Economics – And What Next?" by D.K. Britton, is contained in 1 above.

4. "Changes at the Urban-Rural Interface: The Contribution of Off-Farm Work by Farmers" by Ray D. Bollman. This is one of the Contributed Papers read at the Banff Conference and will form part of *The Rural Challenge:* Contributed Papers read at the 17th International Conference of Agricultural Economists – I.A.A.E. Occasional Paper No. 2, which will be published (and sold) this winter by Gower Publishing Co. Ltd.

Paid-up members of the I.A.A.E. will, of course, be receiving free the publications mentioned in 1 and 4 above.

The following seven publications are available free from the Publications Manager, R.D. and I.A. Branch, Agriculture Canada, Room E-132, Sir John Carling Building, Ottawa, Ont. K1A 0C5.

– **Food Market Commentary**. December 1980, 50 p., Cat. No. A80-751/Vol. 2. No. 4.

– **Food Market Commentary**. September 1980, 40 p., Cat. No. A80-751/Vol. 2 No. 3.

– **Market Commentary – Animals and Animal Products.** December 1980, 66 p.

– **Market Commentary – Farm Inputs**. December 1980, 65 p.

– **Market Commentary – Grains and Oilseeds.** December 1980, 65 pages.

– **Market Commentary – Horticulture and Special Crops.** December 1980, 98 p.

– **Market Commentary – Milk and Milk Products.** December 1980, 25 p.

The following seven publications are available free from Economics and Statistics Service's Publications, Room 0054-South, U.S. Department of Agriculture, Washington D.C. 20250. (Include publication number.)

Burley Tobacco Farming Characteristics and Potential for Change. AER 460.

Domestic Food Programs: An Overview. ESCS 81.

The Farm Pesticide Industry. AER 461.

Indices of Agricultural and Food Production for Europe and the U.S.S.R.: Average 1961-65 and Annual 1970 through 1979. SB 635.

Indices of Agricultural Production for Asia and Oceania, Average 1961-65 and Annual 1970-79. SB 636.

U.S. Foreign Agricultural Trade Statistical Report, Fiscal Year 1979: A Supplement to the Monthly Foreign Agricultural Trade of the United States.

Western Energy: the Interregional Coal Analysis Model. TB 1627.

A Status Report on the World Market for Dairy Products gives comprehensive, detailed information on production, trade, consumption, stocks and international prices in the world dairy market. The 62-page publication is based primarily on information given directly to the General Agreement on Tariffs and Trade (GATT) by dairy producing and consuming nations.

The report covers milk and milk products, including certain milk powders (whole milk powder, skimmed milk powder, buttermilk powder); milk fats such as butter; cheeses; fresh dairy products; concentrated milk, whey, and casein. The report analyzes the evolution of production, trade consumption, stocks, and international prices of these products during 1979 and the first half of 1980, and gives estimates for the second half of 1980 and for 1980 as a whole. A series of 17 tables at the end of the study break down, on a quarterly basis, the main statistics which form the base of the report.

This report is available free, in English, French, and Spanish, from the GATT secretariat, Centre William Rappard, 154 rue de Lausanne, 1211 Geneva 21, Switzerland.

Agricultural Trade in Europe – Recent Developments (Agricultural Trade Review No. 17). Economic Commission for Europe. Sales No. E. 80. II. E. 11. *Available for U.S. $6.00 from the United Nations, Sales Section, New York, or from bookstores.*

The Economics of Production and Marketing of Greenhouse Crops in Alberta. 45 p. 1980 AGDEX 821-1, Economic Services Division, Production Economics Branch, Alberta Agriculture. *Available free from the Print Media Branch, Alberta Agriculture, 9718-107 Street, Edmonton, Alta. T5K 2C8.*

Energy and Industry, the Potential of Energy Development Projects for Canadian Industry in the Eighties. B. Beale. From the Industrial Strategy Series. 1980, 94 p. *Available for $2.00 from the Canadian Institute for Economic Policy, Suite 409, 350 Sparks Street, Ottawa, Ont. K1R 7S8.*

Farm Business Corporations in British Columbia – A Layman's Guide. William A. Barclay, March 1980, 22 p. *Available free from the Ministry of Agriculture and Food, Province of British Columbia, Publications Office, Parliament Buildings, Victoria, B.C. V8W 2Z7.*

Input-Output Price Models and Their Use in Inter-Country Comparisons. Zdenek Drabek. Discussion Paper No. 80-26. July 1980, 41 p. *Available from the Department of Economics, University of British Columbia, 997-1873 East Mall, Vancouver, B.C. V6T 1Y2.*

Principles and Methods in the Testing of Alternative Models. G. Fisher and M. McAleer. Discussion Paper No. 400 from the Institute for Economic Research. August 1980, 35 p. *Available by subscription to the series, for a fee, from the Department of Economics, Queen's University, Kingston, Ont. K7L 3N6.*

IN REPLY

We appreciate your letters and comments on articles in Canadian Farm Economics. Let us know if you think a subject deserves an article and we shall try to accommodate you.

When forwarding your "In Reply," or letter, please indicate if we may publish your comments in a subsequent issue.

Editor's note: We apologize for the delay in mailing the October issue of CFE. It is government policy that French and English editions be mailed simultaneously. Because of the translator's strike, this delay was inevitable.

Dr. A.L. Farley, a professor with the Department of Geography, University of British Columbia, wrote that Soe Lin and G. Labrosse's article, Canada's Agricultural and Food Trade in the 1970s, in our August issue, was a "convenient data source and data interpretation of interest to regional geography. In general, I have found *Canadian Farm Economics* very helpful in a teaching context."

David Arenburg, a government relations officer with the Grocery Products Manufacturers of Canada agrees that the Soe Lin and Gail Labrosse article provides an excellent summary of available statistics.

Don Sweet, director of the Shaw Memorial Library, Milton College, Milton, Wisconsin, 53563 wrote to thank us for extending our service to his school. "We are sure that our student body and faculty will find this periodical to be of great assistance to them."

IN REPLY TO AUTHORS AND EDITORS REGARDING DECEMBER 1980
CANADIAN FARM ECONOMICS

I have read one or more of the following articles:

(1) Canadian Dairy Policy – The Seventies
(2) Measuring Structural Change in the Canadian Farm Industry

1. My comments are on article number (1) (2).
2. On a scale of one to ten how useful was this article to you?

not useful ______________________________ very useful
1 2 3 4 5 6 7 8 9 10

3. Why?

4. How useful was the whole issue to you?

5. Do you have any suggestions or questions on the contents of this issue?

My comments may ( ) may not ( ) be used in a future issue of this publication. (A copy of your comments will be forwarded to the author.)

NAME (Mr., Ms., or Dr.) ______________________________ Occupation ____________
(Please Print)

ADDRESS ____

Please return the above to:

E.A. Love, Managing Editor, Canadian Farm Economics
Information Services
Agriculture Canada, Sir John Carling Building
OTTAWA, Ontario
Canada
K1A 0C5

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

Agriculture
Canada

Canadian farm economics

VOLUME 10
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1 A comparison of selected management practices for East Canadian dairy farms *J. Lovering and J.A. McIsaac*
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A comparison of selected management practices for Eastern Canadian dairy farms

The returns to management on a dairy farm can vary widely from one set of management alternatives to another. There could be as much as $400.00 per cow difference in the returns to management on a 30-cow dairy farm between the situation in which one cut of lightly-fertilized timothy is stored in a stack silo and the cows are housed in a stanchion barn and the situation in which the two cuts of moderately-fertilized timothy are stored in a horizontal silo with formic acid added and the cows housed in a free stall barn.

J. Lovering and J.A. McIsaac

INTRODUCTION

This paper compares some management alternatives available to dairy farmers in Eastern Canada.[1] A benchmark farm business was established and the effects of using the alternatives in the benchmark were estimated.

Labor requirements, capital investment, and net financial returns to management are shown for several management alternatives.

MODEL USED FOR THE ANALYSIS

An existing model of a timothy-based dairy farm (Lovering and McIsaac) was used to examine some management alternatives. The alternatives discussed here have been chosen from those that the model was designed to consider. The model has five components dealing with (1) the growth of the timothy plant, in which the dry matter yield, crude protein, and metabolized energy concentrations of the timothy plant are predicted day by day; (2) the harvest of timothy as either direct-cut or wilted silage or hay, simulated day by day, taking account of the stage of growth, precipitation, and harvest equipment capacity; (3) the storage of the harvested timothy, estimating dry matter, digestible protein, and metabolizable energy losses for several different kinds of silo, with and without the use of formic acid; (4) the determination of optimum ration and milk production from a cow whose forage is the timothy grown, harvested, and stored in the preceding parts, and (5) the estimation of labor, energy, and required facilities to house, feed, milk, and remove manure from the dairy herd. Estimates of investment and annual operating costs are made in each part.

The results in this paper are based on a 30-cow dairy herd. Charlottetown weather and timothy growth functions are used. The only forage grown on the farm is timothy, which is harvested as silage. Enough timothy is grown to exceed the herd's minimum forage requirement but not to exceed the maximum amount that the herd can consume. The timothy growth and harvest were simulated day by day for 10 years. It was assumed that 1076 kg/ha of 15-5-15 fertilizer was applied each year to the crop. The model was run with various minimum yields at which to begin harvest, several harvest system capacities, and various types of silo and barn. The measure used to determine the most economical set of alternatives is returns to management.[2] Returns to management is the farm manager's profit after all expenses have been covered, including the manager's labor at $4.50 an hour.

For a 30-cow dairy herd, there are different areas of timothy that can be grown and various stages of maturity at which the grass can be cut for silage. Table 1 shows the returns to management for a 30-cow dairy herd for two barley and oat prices and two dates for the beginning of harvest. The wilted timothy silage is stored in a horizontal silo with formic acid and covered with polyethylene. The silage is fed out using a tractor with a front-end loader and feed wagons. The cows are housed in a free stall barn and milked in a double-

[1] Eastern Canada includes Ontario, Quebec, and the Atlantic Provinces.

[2] The estimates of receipts, expenses, and net returns shown in this paper are particular to the assumptions used in constructing the timothy-based dairy farm model. They are not necessarily representative of the dairy industry.

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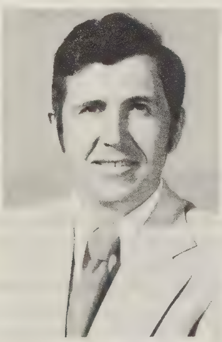

TABLE 1. RETURNS TO MANAGEMENT ($/COW) FOR A 30-COW DAIRY HERD

Cut Strategy[a]	Start of Harvest Cut 1	Cut 2	Barley Price	Oat Price	Hectares 19.5	22	24.5	27	29.5	32
t/ha	date		$/t		returns to management/cow					
3.8/2.7	June 23	Aug. 21	150	150	76	76	72	–	–	–
3.8/2.7	June 23	Aug. 21	187	187	−18	−5	10	–	–	–
2.5/2.0	June 11	July 26	150	150	–	–	–	48	53	58
2.5/2.0	June 11	July 26	187	187	–	–	–	−37	−19	−1

[a]Cut strategy is the minimum yield at which harvest for cuts 1 and 2 may begin.

four herringbone milking parlor with automatic milker detachers. The manure is handled as a solid. The cut strategies shown in Table 1 are defined as the minimum yield at which harvest can begin for cuts 1 and 2. The highest returns to management for the areas shown in Table 1 for the lower priced grains occur at 19.5 and 22 ha. At the higher grain price, the highest returns to management occur at 24.5 ha. At the low grain prices it is profitable to feed less forage and more grain than it is at the higher grain prices. Conversely, at the higher grain prices, it is more profitable to feed more forage and less grain.

SILOS

The horizontal silo with a polyethylene covering and added formic acid has the highest returns to management among the silo types for the situation shown in Table 2. McIsaac and Lovering (1980) show the costs and losses associated with various types of silo. For each silo in Table 2 the amount and quality of the material going into each are identical, except for the oxygen limiting one. The material going into the oxygen limiting silo is wilted to 50% dry matter; therefore higher weathering losses are associated with it. Losses are associated with each type of silo. The labor associa-

TABLE 2. THE EFFECTS OF VARIOUS SILOS, WITH AND WITHOUT FORMIC ACID, ON THE RETURNS TO MANAGEMENT ($/COW), SILO INVESTMENT, AND FEEDING LABOR REQUIREMENTS FOR 30 COWS[a]

Silo Type[b]	Labor[c]	Silo Investment	Returns to Management FSAM[d]	FSAW[e]
	h	$	$/cow	
Tower	106	58 693	−39	–
Tower with formic acid	110	58 693	−55	–
Horizontal with polyethylene covering	150	13 098	–	57
Horizontal with polyethylene covering and formic acid	154	13 098	–	72
Horizontal with roof and polyethylene covering	150	32 953	–	−34
Horizontal with roof, polyethylene covering, and formic acid	154	32 953	–	−21
Stack with polyethylene covering	142	9 506	–	−19
Stack with polyethylene covering and formic acid	151	9 506	–	58
Silo press	155	19 000	–	−15
Oxygen limiting	108	75 860	−88	–

[a]Twenty-four and a half hectares of timothy are harvested as wilted silage. The minimum yield cut strategy for cut 1 is 3.4 t/ha; for cut 2 it is 2.5 t/ha.

[b]Tower silos are made of concrete staves; horizontal silos are of tilt-up concrete construction, the stack silo is a pile of silage on a concrete pad; a silo press is a machine that presses the silage into polyethylene sacks 2.5 m wide and 25 m long.

[c]Man-hours spent in feeding the cows in the barn. Does not include the labor required to fill the silo.

[d]Free stall barn, solid waste, double-four herringbone milking parlor with automatic milker detachers, cows fed by mechanical feeders with forage from a tower silo.

[e]Same as FSAM except that the cows are fed from horizontal silos with feed wagons.

ted with each silo is directly proportional to the quantity of silage removed from it. The tower silos have lower losses and less labor requirements but the high initial cost makes them less economically attractive than the horizontal type. The stack silos are the cheapest to build, but the losses are high.

BARNS

Table 3 shows several barn options and the associated returns to management, capital investment, and the hours of labor required for milking, feeding, and manure handling. The stanchion barns require more labor in the milking and feeding operations than the free stall barns. The cost of the additional labor more than offsets the savings in the annual costs of building ownership. Table 3 indicates that for a 30-cow dairy herd the free stall barn using a double-four herringbone milking parlor with automatic milker detachers, handling manure as a solid, and feeding the animals from a horizontal silo with formic acid added (using feed wagons) is the more profitable. Information on the work rates of milking parlors other than the double-four herringbone was not available. Therefore, the double-four herringbone milking parlor was the only milking parlor option available for the model. While this parlor is more economical than the stanchion barn with a pipeline milker for herds of 30 cows or more, other milking parlors may be more profitable than the double-four herringbone. But at herd sizes of less than 30 cows, stanchion barns may be more profitable than free stall.

There may be situations with the 30-cow dairy herd in which the manager's labor, at $4.50 an hour, is not fully utilized in a free stall barn. In these cases the stanchion barn could be more economical.

The automatic milker detachers reduce the milking labor more than enough to pay for the equipment if the labor is charged at $4.50 an hour. But if the manager's labor is not fully utilized, the automatic milker detachers may not be worth the investment.

TABLE 3. RETURNS TO MANAGEMENT, LABOR REQUIREMENTS, AND BARN INVESTMENT AS AFFECTED BY VARIOUS TYPES OF BARN FOR 30 COWS, 24.5 HA OF TIMOTHY SILAGE, WITH MINIMUM YIELDS AT THE START OF HARVEST OF 3.2 AND 2.5 T/HA ON THE FIRST AND SECOND CUTS

	Tower Silo			Horizontal Silo			Horizontal Silo with Formic Acid		
Barn Type[a]	Initial Cost[b]	Labor[c]	Returns	Initial Cost	Labor	Returns	Initial Cost	Labor	Returns
	$	h	$/cow	$	h	$/cow	$	h	$/cow
FLAW	–	–	–	73 105	1295	20	73 105	1293	37
FL4W	–	–	–	70 155	1506	17	70 155	1511	32
FLAM	72 725	1246	−73	–	–	–	–	–	–
FL4M	69 775	1463	−78	–	–	–	–	–	–
FSAW	–	–	–	66 548	1298	57	66 548	1302	72
FS4W	–	–	–	63 598	1515	52	63 598	1519	66
FSAM	66 168	1254	−39	–	–	–	–	–	–
FS4M	63 218	1471	−44	–	–	–	–	–	–
SSPM	61 681	1947	−84	63 531	2072	−5	63 531	2086	9
SSPC	58 496	2184	−95	60 346	2408	−31	60 346	2412	−16

[a] Barn type code:

first letter:	F – free stall, S – stanchion
second letter (manure)	L – liquid, S – solid
third letter or number (milking)	A – double-four herringbone milking parlor with automatic milker detacher 4 – double-four herringbone milking parlor P – pipeline
fourth letter (feeding)	M – mechanical W – feed wagon C – feed carts

[b] Includes the cost of the barn and barn equipment; does not include silo cost.

[c] Labor includes milking, feeding, and manure handling.

The buildings and equipment needed to handle the manure as a liquid are more expensive than those needed to handle it as a solid. The total labor for handling the liquid manure is slightly less than that required to handle the solid but the labor savings do not compensate for the additional building and equipment costs.

AN OVERALL COMPARISON

Many management options are available to the dairy farmer. Some of these may be economically unsound. Table 4 shows the results that could be expected from two sets of management alternatives. With one alternative (called 'low-return strategy') one cut of timothy is taken for silage, very little nitrogen is applied to the crop, and harvest begins on July 15. The late harvested timothy is low in protein and energy concentration. The silage is stored in a stack silo. The stack silo's storage losses for timothy silage are high, as evidenced by comparing the dry matter yield as harvested and dry matter yield as fed. Forty-nine hectares are grown to obtain enough forage to meet the herd's minimum forage requirements. The cows are housed in a stanchion barn and milked by a pipeline system. Manure is handled as a solid. A tractor with a front-end loader removes the silage from the silo. The returns to management shown in the table are returns to the farmer for his management after his labor has been paid.

The other alternative ('high-return strategy') shown in Table 4 includes two cuts of timothy for silage. In this strategy 80.5 kg/ha of nitrogen is applied in the spring and after the first cut each year. Harvest of the first cut begins on June 23. The harvested crop has high energy and protein concentrations compared with the poor low-return strategy. The timothy is stored in a horizontal silo with formic acid added and covered with a polyethylene covering. By comparing the dry matter yield as harvested and the dry matter yield as fed it can been seen that the storage losses are less than those for

TABLE 4. THE TOTAL COSTS AND RETURNS TO MANAGEMENT FOR TWO DIFFERENT MANAGEMENT STRATEGIES FOR A 30-COW DAIRY HERD

Variable	Low-Return Strategy	High-Return Strategy
Hectares	49	24
Number of timothy cuts	1	2
Nitrogen applied (kg/ha/yr)	34	161
Silo type	Stack	Horizontal with formic acid and polyethylene covering
Barn type	SSPC[a]	FSAW[b]
Total dry matter harvested (kg/ha)	3 347	6 368
Total dry matter fed (kg/ha)	2 061	5 481
Harvest start date — cut 1	July 15	June 23
cut 2	—	Aug. 22
Average crude protein as fed (%)	6.0	11.9
Average energy concentration as fed (MJ/kg M.E.[c])	7.0	8.9
Milk produced (kg/cow/yr)	5 797	5 851
Timothy silage fed (kg/cow/yr)	3 337	4 436
Purchased barley (kg/cow/yr)	2 030	1 135
oats (kg/cow/yr)	171	169
SBOM[d] (kg/cow/yr)	463	177
urea (kg/cow/yr)	60	30
Total supplements (kg/cow/yr)	2 727	1 513
Total labor (h/yr)	2 840	1 716
Total investment ($/cow)	8 293	7 811
Annual costs — barn ($/yr)[e]	34 326	31 778
silo ($/yr)	2 630	4 331
Total annual costs ($/yr)	74 914	63 625
Total revenue ($/yr)	65 178	65 790
Returns to management — farm ($/yr)	−9 736	2 165
per cow ($/cow/yr)	−325	72

[a] Stanchion barn, solid waste, pipeline milker, animals fed using feed carts.

[b] Free stall barn, solid waste, milking parlor with automatic milker detachers, animals fed using feed wagons.

[c] Metabolizable energy.

[d] Soybean oil meal.

[e] Includes the costs associated with the cows, building, and related equipment, does not include the forage and supplement costs.

the stack silo. The animals are housed in a free stall barn and milked in a double-four herringbone milking parlor with automatic milker detachers. The manure is handled in its solid form. The animals are fed using feed wagons which are loaded from the silo by a tractor with a front-end loader.

The difference in the returns to management for the two situations outlined in Table 4 are due to the barn, silo, and harvest strategy chosen. The stanchion barn is cheaper to build but takes more labor to operate (feeding, milking, and manure handling) than the free stall barn. The losses from storing the timothy in the stack silo are high. In this case the dry matter loss is 38%. The silage was harvested late (July 15) and very little nitrogen was applied to the growing crop. Hence, the dry matter yield per acre was low (3347 kg/ha) as well as the protein and energy concentrations (6.0% and 7.0 MJ/kg). Forty-nine hectares of timothy were grown to help meet the minimum forage requirements of the dairy herd. This represents a much larger investment in land compared with the situation in which 24.5 ha of timothy were grown. Because of the low protein and energy concentrations of the timothy, more barley, soybean oil meal, and urea are fed to help meet the protein and energy requirements of the dairy cow (Table 4). As a result of several poor management decisions the dairy farm could be suffering substantial ($325/cow) losses each year instead of making a slight ($72/cow) profit.

CONCLUSIONS

Several management alternatives are available to the dairy farm manager. He has many choices to make concerning what crops he will grow to feed his herd, how he will manage those crops, and how he will manage the dairy herd. In this article we have considered a dairy farm where the only forage grown for the animals is timothy which is harvested and stored as silage. There are trade-offs to be made when considering many of the alternatives. Some of these include trade-offs between storage costs and storage losses for silage and barn costs versus labor for barn chores.

Based on the assumptions made in this article for a 30-cow dairy herd, the management alternatives that result in the highest returns to management for the farm are as follows: 19.5 ha and 22 ha of timothy silage with 537 kg/ha of 15-5-15 fertilizer applied in the spring and after the first cut; a first cut harvested in mid-June and a second in mid-August; silage stored in a horizontal silo with formic acid and a polyethylene covering; animals housed in a free stall barn, milked in a double-four herringbone milking parlor equipped with automatic milker detachers, and fed from the silo with a feed wagon; and manure handled as a solid.

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Economic benefits to N.S. feed grain producers from timeliness improvements in spring field operations

This article discusses the economic setting for cereal production in Nova Scotia. A strategy for improving the profitability of producing cereals based on reducing the dependence on weather during spring planting is outlined. This strategy calls for increased investment in tillage and planting equipment. It showed promise for barley, mixed grains, and wheat, but not for oats. The analysis suggests that the cereal crops could be practical for many Nova Scotia farms.

J.A. Dyer, J. Girt, and S.C. Lok

INTRODUCTION

Nova Scotia is a net importer of feed grains. In 1979, for example, the province consumed 235 000 t of grain, of which 90% were imported (Redmond 1980). Agriculture Canada and the provincial government have traditionally supported local feed grain production through research and extension work. Federal-provincial cost-shared development agreements, such as the Canada-Nova Scotia Agricultural Subsidiary Agreement, 1976 to 1981, have offered financial incentives to farmers to expand grain production. The rationales for these programs include a desire to increase the productivity of agricultural resources in the province, and to ensure a local supply of feed grains.

Cereals are not a popular crop in Nova Scotia. They are grown on only about 15% of the total area of field crops within the province. The types of grain being grown there have been changing. The area sown to oats has declined significantly since the 1940s, while the areas of the other varieties have been increasing. Table 1 gives the areas sown to these crops, with the exception of corn, for selected years since 1961. Although successes are being reported for fall-sown crops, the majority of cereal producers continue to grow spring-sown varieties.

TABLE 1. AREA SOWN TO SMALL GRAINS IN NOVA SCOTIA FOR SELECTED YEARS

Crop	1961	1966	1971	1976	1978	1980
	hectares					
Wheat	550	550	1 920	1 530	1 940	2 600
Oats	15 180	10 400	7 200	7 650	6 680	7 600
Barley	440	1 450	3 520	1 820	1 700	2 200
Mixed grain	3 440	4 080	3 440	2 340	2 500	2 640

Sources: *Agricultural Statistics Vol. 14,* Province of Nova Scotia; and L.V. Redmond, Statistics Canada, Truro, Nova Scotia (personal communication).

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TABLE 2. BREAK-EVEN YIELDS VERSUS REPORTED YIELDS FOR SELECTED FEED GRAINS IN NOVA SCOTIA

Crop	Production Costs/ Hectare[a]	Purchase Costs/Tonne (As a Feed Ingredient)[b]	Selling Price/ Tonne on Commercial Market[b]	Break-even Yields On-Farm Feed	Break-even Yields Commercial Product	Estimated Mean Provincial Yields 1976	1977	1978	1979	1980
	—	$	—	—	t/ha —	—		t/ha		—
Wheat	350	171	118	2.0	3.0	2.9	2.4	3.0	2.8	2.9
Barley	338	127	90	2.7	3.8	2.6	2.2	2.9	2.3	2.7
Oats	332	149	86	2.2	3.9	2.0	1.7	2.2	1.7	2.2
Grain corn	452	171	150	2.6	3.0	5.9	5.2	3.7	0.9	—
Mixed grain	336	136	88	2.5	3.8	2.6	2.1	2.6	2.1	2.4

[a]N.S. Department of Agriculture and Marketing (NSDAM), Extension Services Branch, Farm Management Division, 1979, excluding interest charges, labor at $3.50/h and 25% of fertilizer costs and milling charges.

[b]Hayman, R.L. and D.K. Clark, *Economics of On-Farm Feed Processing,* Farm Management Division, NSDAM, 1979; except grain corn and mixed grains supplied by Economics Branch, NSDAM.

[c]NSDAM, *Agricultural Statistics, Vol. 14,* 1979; and L.V. Redmond, Statistics Canada, Nova Scotia (personal communication); except figures for grain corn supplied by Agriculture Canada, the Regional Development and Analysis Division, Truro, Nova Scotia.

CRUCIAL FACTORS AFFECTING FEED GRAIN PRODUCTIVITY IN NOVA SCOTIA

Assuming that farmers select the most appropriate of the available cereal varieties for maritime conditions, the factors most likely to affect yields are weather, soil quality, and farmers' production practices. Weather conditions in the spring and fall, and cereal growers' reaction to them are major influences on cereal yields (Lok *et al.* 1979). Wet fields, which often retard spring planting, can dramatically affect yields. Similarly, wet conditions in the fall can hinder harvesting and result in crops spoiling in the field.

In Nova Scotia, soil conditions generally affect cereal yields in two ways – through texture and nutrient deficiencies. Light soils are prone to mid-summer droughts and heavy soils suffer from spring and fall waterlogging. Soil conditions affect the nutrients available to plants. To some extent nutrient deficiencies can be ameliorated by fertilizing and liming. In poorly drained soils, drains can reduce waterlogging, particularly where the watertable is near the surface in the spring. However, even with drainage, weather conditions still remain a serious challenge to the Nova Scotia cereal producer, particularly in spring. Weather cannot be controlled but farm practices can.

COSTS AND RETURNS FROM NOVA SCOTIA CEREAL PRODUCTION

Since the most popular use of agricultural land in Nova Scotia is for hay and pasture, this study was extended to those farmers contemplating grain production as well as those already growing grain. Cereal production costs were therefore estimated for 1979 by adjusting the total costs of production calculated by the N.S. Department of Agriculture and Marketing (NSDAM) to reflect the additional costs of using land for cereal production instead of for grass. This meant that costs of land, buildings, and machinery (except harvesting equipment which was hired) were deleted. Labor charges were also ignored under the assumption that the farm operator or his family performed all the work. Fetilizer costs in the provincial study were reduced 25% as farmers' animal manure could be used as an alternative.

These costs and grain prices were assumed to be fixed at 1979 levels, although in reality they are variable. Thus this paper only illustrates what can be achieved with this methodology. The model used can be calibrated for other costs and prices, and the conclusions modified accordingly.

Assuming a production area of 40 ha, the additional production costs of cereals were calculated (Table 2). In 1979 the costs of cereals purchased as grain, or the price when sold as a commercial product, implied that to break even yields of the various crops had to be more than 2 t/ha in all cases to replace purchased feed, and at least 3 t/ha to be a viable commercial product . The remaining columns in Table 2 indicate that mean provincial yields were sufficient between 1976 and 1980 to make replacing purchased feed with an on-farm grown product an attractive economic proposition for many farmers (except for oats). The situation is much less attractive for the commercial sale of N.S. grain.

Statistics Canada obtains the average provincial yields in Table 2 from a survey of farmers. These yields fluctuate from year to year because of weather and changing farming practices and are generally well below possible yields. In 1975, for example, yields of 3.9 t/ha for spring wheat were reported for one farm (Peill and Milligan 1978), compared with an average provincial yield of 2.2 t/ha (NSDAM 1979). However, these average yields can be used to measure the relative performance of N.S.

cereal producers and to determine the effect of field operations in minimizing the impact of weather. This could be done for only oats, barley, and mixed grain. There was insufficient data for grain corn and the data for wheat did not distinguish between spring and winter varieties.

Late planting has two effects on cereal production. It reduces the length of the growing season and delays harvest dates well into the rainy fall season when inadequately dried plant tissues, as well as fields which are not traversable, are likely to cause harvesting problems (Dyer and Bootsma 1979 and Dyer 1980). The annual mean yields of oats, barley, and mixed grains in Nova Scotia are significantly related to the number of rain-free days between May 21 and May 30 in each year at Kentville. Weather conditions in other spring and fall periods were not significantly related.

There is also a high degree of similarity in the number of rain-free days in spring and fall between meteorological stations in the main agricultural areas of Nova Scotia and New Brunswick. For instance, field workday estimates for Nappan and Kentville are almost identical (Baier *et al.* 1978). Data from Kentville were selected as representative of weather conditions in the Annapolis Valley, Colchester County, and Northumberland Strait areas of Nova Scotia.

Detailed linear regression results (Table 3) show that average yields of oats, barley, and mixed grains increased 0.07, 0.13, and 0.13 t/ha for each additional rain-free day in the May 21 to May 30 period. The analysis suggests that if a greater percentage of cereal growers prepares more land per day that is suitable for field work to finish planting by the end of May, mean provincial cereal yields would increase. Thus if the average cereal grower were to plant on time every year (100% of the time) mean yields would be 0.7, 1.3, and 1.3 t/ha greater for oats, barley, and mixed grain than if he had never planted on time.

TABLE 3. STATISTICAL EFFECTS OF RAINY DAYS FROM MAY 21 TO MAY 30 ON PROVINCIAL MEAN YIELDS, 1961-76

Crop	a	b	R^2
Oats	1.17	0.070	0.35
Barley	1.34	0.132	0.28
Mixed grain	1.46	0.134	0.32

Interpretation:

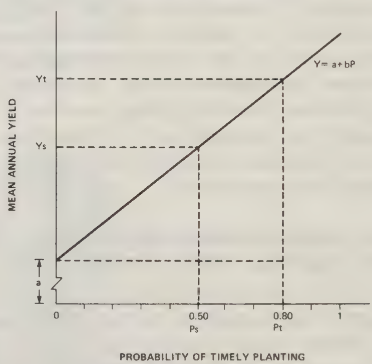
- If every day between May 21 and May 30 had rain, provincial yields for each grain would be given by the 'a' coefficients in tonnes per hectare.
- For each day without rain, yields increase by the 'b' coefficients in tonnes per hectare.
- R^2 gives the proportion of the variability in yields from year to year explained by rain conditions during this period.

Unpublished data are available from Statistics Canada which show the percentage of farmers who had sown their cereal by May 31 in any year. For Nova Scotia, these data reveal that the majority of cereal growers plant on time approximately 50% of the time.[1] This figure is supported by other sources which suggest that only 54% of the province's farmers have their spring crops planted by May 31 (Statistics Canada 1978).

For simplicity's sake it was decided to concentrate exclusively upon the variable group of farmers who planted on time in some years but not in others. That proportion of farmers who always planted on time (approximately 5% of the sample) were ignored, as well as those who never planted on time.

The yield increases described above were scaled to the variable group of farmers. First the maximum possible improvement in their yields was calculated by scaling the increases given in the regression analysis for the whole farm population to the proportion of farmers who are 'sometimes' on time. Thus, to these farmers the value of always being on time opposed to never being on time is an increase of 0.8, 1.4 and 1.7 t/ha for oats, barley, and mixed grains. Second, adjustments were made according to the percentage of time that these farmers actually planted on time. Figure 1 shows the relationship between yield increases and the probability of planting on time. Increasing the numbers of farmers who do plant on time could improve the economic returns from cereal production in the province if the costs of becoming more timely did not outweigh the increased returns. The increased returns can be inferred, but the additional costs of improved timeliness have to be established, as does an acceptable level of timeliness.

THE EFFECT OF IMPROVED TIMELINESS ON YIELDS



a= Constant base yield achieved even if always untimely
Ps= Probability of being timely under current levels of mechanization
Ys= Average yields associated with timeliness level/Ps
Pt= Probability of being timely under upgraded levels of mechanization
Yt= Predicted average yields with "Pt" timeliness level

Figure 1

Since it would be unreasonable to expect all farmers to plant on time every year in Nova Scotia, given its climate, a target of planting on time 80% of the time was chosen; in other words, farmers should adopt a cereal growing system that would result in their crops being sown by May 31 in 4 years out of 5. Farmers are currently planting on time approximately half the time. The improvement in timeliness (50% to 80%) shown in Figure 1 for the farmer who sometimes plants on time would result in mean annual yield increments of 0.3, 0.4, and 0.5 t/ha for oats, barley, and mixed grains. If this increased production replaced purchased feed, the farmer's annual savings on grain purchases would be $45, $55, and $66/ha for the three crops.

ADDITIONAL COSTS

The increased costs of planting on time were assumed to be the additional farm machinery required to complete planting in a shorter period. Tables have been published of the number of spring, field workdays, based on weather records, that can be expected at several Atlantic region sites (Baier *et al.* 1978). These tables provide workday estimates at the existing and the target probability levels chosen above. In half the years at Kentville, Nova Scotia, by May 31 on a well-drained loamy soil, 14 field workdays could be expected. In four fifths of the years only 9 workdays are expected. Assuming, for example, that the average farmer is equipped to prepare his fields in 8 days and to seed in 6, he would have to condense these activities into 9 days (6 for preparation and 3 for seeding) to plant on time 4 out of 5 years. Work would have to be accomplished at a faster rate, requiring more machinery or changing the specifications of existing equipment. Implements, for example, tandem-disc harrows, moldboard plows, and seeders, would have to be wider and the tractors used to pull them larger. Better scheduling of the farm operations might also be needed.

A computer program (Dyer 1978) based on work by Hahn (1971) was used to calculate the minimum tractor horsepower and corresponding implement sizes required to prepare and plant small grains by the last day in May, 50% (the current situation) and 80% (the more timely situation) of the time on 10 to 100 ha of rolling, silty, clay-loam soil which was slightly stony and well-drained. The additional farm machinery costs associated with moving from planting on schedule 50% of the time to 80% of the time were estimated using 1979 price quotations from local farm machinery dealers. It was assumed that these costs would be covered by borrowing over 10 years at a real interest rate of 10%. The minimal quote for obtaining the necessary new equipment was always used. Figure 2 shows the annual increased costs associated with improving planting time during this 10-year period for different areas of cereals.

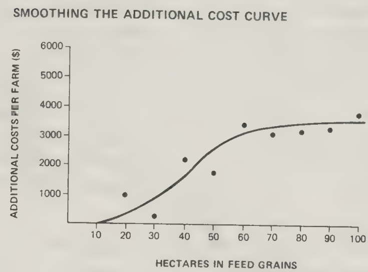


Figure 2

Since the tractor program was designed not to minimize costs but to minimize tractor horsepower requirements to complete field preparation and sowing in a specified period, the costs in Figure 2 fluctuate considerably. These were further magnified when constraints on implement sizes were encountered. For example, on some fields larger machinery than necessary was used because acceptable smaller sizes were unavailable. In general, marginal machinery costs were minimized by moving to a two-tractor system with one tractor both discing and seeding. It is assumed that no additional labor inputs were required. Labor already available on the farm was put to more intensive use.

To establish some general recommendations for N.S. cereal production, the addition costs in Figure 2 were generalized into a sigmoidal curve intuitively fitted through the plotted points. Using this additional cost curve, Figure 3 demonstrates how the profitability or net returns of improved timeliness, that is, additional returns less additional costs per hectare, varied with the size of area sown. Farm operators with small areas of oats and barley should currently be able to achieve small increases in profits (or reductions in losses), because the smallest machinery available is adequate at almost any timeliness level. The net returns to operators growing 40 to 80 ha of oats would not appear to be sufficient to offset expected capital cost increases. For all three crops improved timeliness seems economic for larger areas.

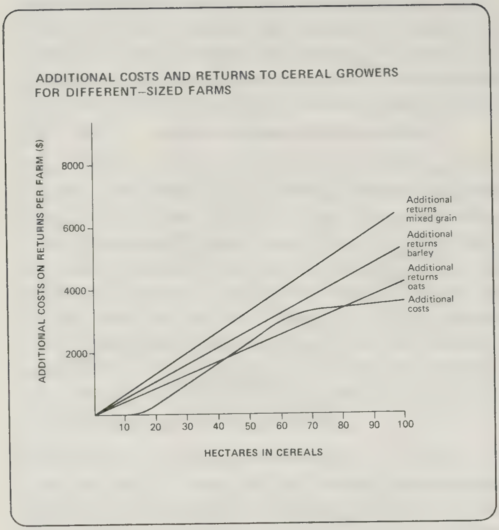


Figure 3

DISCUSSION

Emphasis in this paper has been on the economics of increased investment to improve the timeliness, rather than upon the overall profitability, of cereal production. Actual returns to farmers vary considerably. Many producers obtain yields well above the provincial average.

Generally, when provincial average yields and provincial estimates of production costs are used, grain production appears to be a losing proposition. However, the costs of production used are those necessary to obtain a high yield. By using the inputs associated with these costs, a cereal grower should realize above-average yields, assuming that soil conditions and management practices are acceptable. What these yields would be can only be conjectured. In Table 5 the break-even yields required to cover costs with and without the investment needed to maximize timeliness were compared with recent average yields, and to what these yields could have been with an improved level of timeliness. Break-even yields were closer to actual or inferred yields for barley and mixed grains than for oats. It also appears that increasing investment to improve timeliness may not be justified for oats at current prices but that the net income from barley, mixed grains, and probably wheat would be improved if more timely planting practices were adopted.

Purchasing a larger or another tractor to improve timeliness would have other advantages not mentioned in this study. For example, a new machine would considerably reduce downtime (time lost when breakdowns occur). In a two-tractor system, a second machine would serve as a back-up. This could benefit other farm operations throughout the season. Changing from one to two tractors costs less than replacing a single small tractor by a larger tractor because fewer implement changes are generally required.

TABLE 4. MEAN YIELDS THAT FARMERS CAN EXPECT WHEN THEY DO AND WHEN THEY DO NOT PLANT ON TIME

Crop	Proportion of Farmers Growing Variety Who Sometimes Plant on Time	Expected Mean Yield in Years When not Planting on Time	Expected Mean Yield in Years When Planting on Time
		– t/ha	–
Oats	0.89	1.2	2.0
Barley	0.91	1.3	2.8
Mixed grain	0.81	1.5	3.1

This study has only examined the benefits of timeliness with well-drained soils. In areas with poor drainage, the number of spring workdays would be significantly less than those used here, a factor which would modify the shape of the cost curves. Workday inputs were based on silty clay-loam soil. Sandy soils were not used because their workday variability is much less sensitive to weather than that of heavier soils (Baier *et al.* 1978). Also, most fields suitable for grain production are on soils with a relatively high clay content.

Applying timeliness improvements to oats appears to be a losing proposition on all but the smallest farms, despite the relatively high price it commands as an on-farm feed replacement. Barley and mixed grains offered the highest benefits of planting, especially on larger areas. Farm operators with grain areas of less than 20 ha cannot blame their untimeliness on poor weather since estimates made here show that their current level of mechanization should be sufficient to complete early planting at either 50% or 80% profitability.

CONCLUSIONS

Since the foregoing analysis suggests that improving the timeliness of spring planting offers increased revenues to many local producers, the extension and other support programs aimed at crop productivity improvements should carefully consider field operation scheduling as a fundamental farm management tool. Because marginal profits varied with field sizes, the tactics used to promote timely planting would necessarily depend on the size of farm operation. For instance, many small operators appear to have enough machinery, but should schedule field work more carefully in spring. Larger farm operators need to appraise the working capacity of their machinery in terms of the amount of work required and the work time available. They should also carefully consider the size of the area sown to cereals, as

TABLE 5. BREAK-EVEN YIELDS TO COVER PRODUCTION COSTS WHEN FARMERS PLANT ON TIME AND WHEN THEY DON'T PLAN ON TIME

Crop	Mean Provincial Yield, 1976-79	Break-even Yield for Use as On-Farm Feed for 40 ha	Expected Mean Yield with Improved Timeliness	With Improved Timeliness Break-even Yield for Use as On-Farm Feed for: 40 ha	80 ha
			t/ha		
Oats	1.9	2.2	2.2	2.6	2.5
Barley	2.5	2.7	2.9	3.1	3.0
Mixed grain	2.4	2.5	2.9	2.9	2.8

proportionately more benefits from timeliness accrue to large and small than to medium areas.

This analysis considered only increased mechanization as a means of achieving better timeliness in spring, but it does not negate the need to use tile drains where water tables are slow to recede. Other options, such as dual wheels and four-wheel drive tractors to increase flotation and traction, can also permit earlier seeding. However, although such machinery may allow work to continue on waterlogged fields, care must be taken to avoid damaging soil structure. Thus, real worktime gains are often very limited.

The methods used here constitute a simple method for regional farm planning and the results provide a guideline for increasing N.S. feed grain productivity. The analysis was based entirely on secondary information sources and gross conceptual models, and it only used one weather recording site. Such an approach was used because very little data have been collected on farm field operations. Solving for two selected probability levels simplified the analysis so that it could be applied to a range of field sizes. The conclusions reached here could be strengthened by redoing the analysis at another site for comparison. A similar analysis is recommended for fall field work. An assessment of the impact of these productivity increases on the economics of the N.S. livestock industry would also be useful. In addition, it would be possible to conduct a study such as this one on individual farms using data on their specific costs and yields.

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U.S. farm programs for wheat and feed grains

U.S. farm commodity programs are used to manage supplies and to provide price and income support to farmers. This article describes the principal features of U.S. commodity programs for wheat and feed grains and how they are used to achieve these two objectives. Appendix A discusses the agencies involved in the commodity programs and their functions, while Appendix B provides a summary of the programs' operations for the 1978-81 wheat and feed grain crops.

C.V. Fulton

INTRODUCTION

This article describes the principal features of the voluntary wheat and feed grain programs of the 1977 U.S. Food and Agriculture Act.[1] Although there have been many changes in the details over the years, the major farm commodity programs found in the 1977 act are similar to those devised and implemented in the Agricultural Adjustment Act of 1933. "The principal features of the 1933 act were acreage controls, payments to farmers agreeing to abide by the acreage limitations, and price supports."[2] Earlier efforts to offset the decline in farm income through voluntary production control had failed.

Throughout the years "the basic philosophy has remained that government must intervene to adjust supply to maintain prices that are politically acceptable, or failing to achieve an increase in prices, to make payments to producers of certain farm crops to bring returns to an acceptable level."[3] The Food and Agriculture Act of 1977 provides provisions for government to alter production, support farm prices, or raise farm incomes. These provisions are as follows:

1. acreage set-aside program,
2. paid acreage diversion program,
3. commodity loan program,
4. target price program,
5. disaster payment program, and
6. farmer-held reserve program.

The set-aside and acreage diversion programs are used to manage supply by encouraging producers to reduce their planted area of certain crops. These are back-up programs for the more fundamental programs of income support and stabilization. The other instruments are income support programs. The commodity loan program provides price support by establishing a floor price for commodities, while the farmer-held reserve program supports prices by isolating grain stocks from the market. The target price programs provide direct income support through deficiency payments when market prices fall below target prices, whereas the disaster payment program provides payments to producers for crop disasters or low yields.

ACREAGE SET-ASIDE PROGRAM

The acreage set-aside program is implemented whenever the U.S. Department of Agriculture (USDA) forecasts excessive supplies of certain major crops, that is, when supplies of these crops are excessive relative to expected domestic and export requirements. Farmers who want to benefit from farm program protection during periods of excessive supply are required to set aside without payment a specified portion of their land from producing certain major crops. This set-aside land is to be planted to legumes, grasses, or other conserving crops for protection against weeds and wind and water erosion. In return, farmers are eligible for loans to help them store and market their production, assured of minimum prices for their program crops, covered by disaster protection, and eligible to participate in the farm reserve. Although farmer participation is voluntary, those who do not participate are ineligible to receive benefits from these other programs for that crop year.

[1] This act is under review as it is set to expire in 1981. Changes to some of the principal features are being considered. New legislation will have to be in place late this summer.

[2] Johnson, D. Gale, *Farm Commodity Programs: An Opportunity for Change* (Washington, D.C.: American Enterprise Institute for Public Policy Research, May 1973), p. 1.

[3] Ibid.

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Before deciding on a set-aside for a particular crop, the national program acreage (NPA) is first determined by the USDA's Agricultural Stabilization and Conservation Service (ASCS [Appendix A, Section 1]). The NPA is the number of crop acres needed to meet projected domestic and export demand (less imports) plus any desired adjustments in ending stocks. The NPA for each crop is determined by dividing the estimate of projected utilization by a national average program yield to obtain the needed harvested acreage. This acreage is then used to determine whether a set-aside is necessary and if it is, what percentage of cropland is to be set aside. For wheat the set-aside and NPA have to be announced by August 15 and for feed grains by November 15 of the preceding calendar year, that is, for wheat harvested in 1981, the program had to be announced by August 15, 1980. The NPAs may be adjusted later in light of more recent information.

The 1977 act authorizes the concept of a 'normal' crop acreage (NCA) for an entire farm. A farm's NCA is computed by county ASCS committees based on 1977 plantings of designated crops (Appendix A, Section 2). For a farm to be eligible for program benefits when a set-aside program is in effect, its acreage planted to designated crops plus any set-aside cannot exceed the established NCA.

There is also a cross-compliance provision in the set-aside program in which the farmer has to comply to be eligible for program benefits. For example, if a farmer plants both wheat and sorghum, then he has to set aside the prescribed acreage for the two crops, if a set-aside program is in effect for both wheat and feed grains.

PAID ACREAGE DIVERSION PROGRAM

When supplies are determined to be substantially in excess of anticipated demand, a paid acreage diversion program can also be implemented to encourage farmers to divert additional cropland out of crop production. If a set-aside program has been announced, then farmers must participate in the set-aside to be eligible to participate in the diversion program. However, if no set-aside has been announced for a particular year, and if circumstances later indicate a need for an acreage diversion program, then a diversion program can be implemented. The diversion payment to an individual farmer is usually based on so much per bushel times the production from his planted acreage. Production is determined by multiplying the acreage planted for harvest by the farm yield (established by the ASCS). A wheat grazing and hay program may also be implemented. Under this program farmers are allowed to graze out their wheat or harvest the wheat as hay with the acreage not to exceed 50 ac or 40% (whichever is larger) of their total intended acreage of wheat, feed grains, and upland cotton for harvest. In return, the farmer would receive the same deficiency payment as that received for wheat harvested as grain. Under the acreage set aside and diversion programs, the acreage planted, set aside, and diverted cannot exceed the farm's NCA to be eligible for program benefits.

COMMODITY LOAN PROGRAM

The 1977 Food and Agriculture Act continued the non-recourse loan program which provides price support protection to farmers, a basic part of the farm commodity program. A producer complying with the requirements of the various farm programs can commit any quantity of his crop as collateral for a loan with the Commodity Credit Corporation (CCC [Appendix A, Section 3]). The total amount that can be borrowed from the CCC is equal to the quantity of the crop placed under loan times the loan rate. Non-recourse loan contracts are written with a maturity date and a fixed interest rate for the life of the contract. The loans mature on demand, but usually no later than the last day of the ninth calendar month following the month the loan is made.

The 1977 act sets the minimum loan level or rate for the 1978-81 wheat crops at \$2.35/bu and for the 1978-81 corn crops at \$2.00/bu. These are national average levels with variation in levels among states (Appendix A, Section 4). The maximum loan level for wheat cannot exceed 100% of parity, which in February 1981 was \$6.98/bu (Appendix A, Section 5). Loan rates for the other feed grains, sorghum, oats, and barley are to be established at a fair and reasonable level in relation to corn, with feed value and other factors taken into consideration, and in particular the average transportation costs to market grain sorghum in relation to corn. There is a provision in the 1977 act that when it is necessary to maintain domestic and export markets, the Secretary of Agriculture may lower loan levels for wheat and feed grains. A maximum adjustment of 10% can be made for the crop year if the national average price that producers receive for the commodity in the current crop year is not more than 105% of the current year's loan level. While the maximum annual adjustment is 10%, the loan rate cannot in any event be less than \$2.00/bu for wheat and \$1.75/bu for corn.

The loan rate is set so that the interest-bearing loans will allow farmers to repay basic 'operating' costs, and thus permit farmers to market their crops later in the crop year when markets are less congested than they are at harvest time. The loan rate is not intended to cover all production costs.

On the loan's maturity date or any time before maturity, producers may retain possession of their crop by repaying the loan plus any interest. Alternatively, if a producer chooses not to redeem his loan, the CCC takes title to the grain as full payment for the loan and accrued interest. It is this second option which allows these loans to be referred to as price-support loans. There is a third option which places grain in the farmer-held grain reserve. In this situation the repayment of the loan plus interest is not due until the grain is removed from the reserve.

TARGET PRICE PROGRAM

The Food and Agriculture Act of 1977 continued the dual target price and loan programs, providing price and income support protection to farmers. The target price program guarantees eligible producers a direct payment if farm prices received fall below established target prices. Target prices are used to establish a basis for providing deficiency payments to producers who participate in the wheat and feed grain programs. Deficiency payments vary inversely with market prices. No payments are made if the average price received by farmers is at or above the target price. If the average price that farmers receive is below the target, then payments are based on the difference. However, in no instance will deficiency payments exceed the difference between the commodity loan rate and the target price.

The 1977 act specified target prices for wheat and corn for 1978 and a target price adjustment formula for 1979-81 wheat and corn crops. For the 1979-81 crops, the previous year's target prices for wheat and corn are adjusted to reflect changes in a moving 2-year average production cost estimate, with the cost components being considered limited to variable, machinery ownership, and general farm overhead costs (Appendix A, Section 6).

The 1977 act specified that the target price for the 1978 wheat crop would be either \$3.00 or \$3.05 depending on whether or not actual production exceeded 1.8 billion bushels. For 1978 the corn target price was \$2.10/bu. The target prices for sorghum – and if designated, oats and barley – are to be set at a rate that is fair and reasonable in relation to that established for corn.

Associated with the target price program is a recommended voluntary acreage reduction provision. Producers who voluntarily reduce their acreage planted for harvest from the previous year by the percentage recommended by the Secretary of Agriculture are eligible to receive any required deficiency payments on 100% of their harvested wheat and feed grain acreage. Producers who voluntarily reduce planted acreage from the preceding year's would also have to meet the acreage set-aside requirements to qualify for program benefits. Producers who do not reduce their plantings by these recommended percentages are subject to a program allocation factor of between 80 and 100%.

A program allocation factor of between 80 and 100% is calculated for the United States for each crop. To arrive at an allocation factor for each crop, the national program acreage for each is divided by the harvested acres of the crop. The allocation factor is then used to determine the farm program acreage. The same factor is applied to all farmers who reduce their planted acreage by less than the recommended amount. The individual farm program acreage for deficiency payment purposes is determined by multiplying the allocation factor by the number of acres planted for harvest on the individual farm.

Deficiency payments are made to eligible producers of each feed grain crop and wheat crop if the weighted national average price that farmers receive during the first 5 months of the crop year is below the established target price for that crop year (Appendix A, Section 7). The payment rate is determined by the difference between the target price and the higher of the national weighted average farm price or the loan price. For the 1978-81 wheat and feed grain crops, the total amount of deficiency payments received by a producer in each year is determined by multiplying the payment rate with the farm program acreage and by the farm program payment yield established for the farm.

The entire acreage of any crop on which payments are made to a producer on a farm is reduced by the number of acres on which a disaster payment is made. Thus a producer cannot be paid twice for the production from the same acre.

There is a total payment limitation for deficiency and diversion payments which an individual can receive under a single program or a combination of the feed grain, wheat, and upland cotton programs. Maximum payment limits per individual were \$40 000 in 1978, \$45 000 in 1979, and \$50 000 in 1980 and in 1981. This limitation does not apply to CCC commodity loans or purchases or disaster payments.

The target price for each crop is calculated according to a formula prescribed in the Food and Agriculture Act of 1977. If a set-aside program is in effect, the Secretary of Agriculture may increase the target price above the formula level to compensate producers for participation in the set-aside program. Because there was no set-aside for 1980 wheat and feed grain crops, the target prices for these crops would have reverted back to the cost of production formula levels. However, the Agricultural Adjustment Act of 1980 passed in March raised target prices for 1980 wheat and feed grain crops. The new target prices for these grains are significantly above the formula levels. To discourage producers from planting

more than their normal crop acreage in 1980, the USDA announced that these farmers would be only eligible to receive disaster and deficiency payments (or both) based on target prices set out in the Food and Agriculture Act of 1977. They would, however, qualify for normal loan rates and the farm reserve options.

DISASTER PAYMENT PROGRAM

The Food and Agriculture Act of 1977 extended the disaster payment program through the 1979 wheat, feed grain, upland cotton, and rice crops. Because of delays in the passage of a comprehensive government crop insurance program, the Agriculture Adjustment Act of 1980 extended the disaster payment program for these crops to 1980. Producers were eligible for disaster payments based on the higher target price levels provided they stayed within their NCA. A payment limit of $100 000 per person was placed on combined disaster payments under all programs in 1980.

Under the disaster payment program, a producer qualifies for payment if he is prevented from planting the crop because of a natural disaster or circumstances beyond his control; or if he has yields that fall below 60% of the farm's established yield. Under the prevented planting option, payments for wheat and feed grains are computed on 75% of the established farm yield times one-third of the applicable target price times the acres eligible for payment. For the low yield option, payments are 50% of the applicable target price for wheat and feed grains times the production deficit below the 60% level. To be eligible for either prevented planting or low-yield disaster payments, producers must comply with any set-aside program in effect.

The Federal Crop Insurance Act of 1980 passed in September established a more comprehensive all-risk crop insurance program and provided for the federal government to share with farmers the cost of insurance programs. For 1981 crops, producers can choose one of two options. First, they can pay the full cost of the 1981 Federal Crop Insurance premium and retain full eligibility for disaster payments in 1981. Second, they can decline eligibility for disaster payments and have the cost of their 1981 Federal Crop Insurance premium reduced 30% for coverage of up to 65% of their established farm yields.

FARM RESERVE PROGRAM

The farmer-held grain reserve program was initiated with the Food and Agriculture Act of 1977. The legislation requires the Secretary of Agriculture to administer a farmer-held storage program for wheat, and at his discretion a similar program for feed grains. Storage is accomplished through an extended price support loan program for 3 to 5 years. Farmers receive payments for storing the grain. The secretary may adjust or waive interest charges on the reserve loans.

The farmer-held grain reserve is designed to isolate excess grain supplies from the market by permitting farmers with grain under a CCC loan to put it in the reserve. Farmers receive storage payments for their reserve grain whether it is stored on the farm or in commercial facilities. The CCC pays annual storage payments in advance and if the commercial storage rates are more than the CCC payments, the farmer is responsible for the difference. Grain is released from the reserve when market prices rise to specified levels as a result of tightening supplies and stronger demand. Thus the reserve attempts to provide a more stable balance between supply and use by adjusting market supplies to demand through the isolation of excess stocks from the market.

As a CCC commodity loan approaches maturity a producer can decide either to redeem the loan or extend it for 3 to 5 years beyond the maturity date by placing the grain in the farmer-held grain reserve. Producers are not eligible to place grain in the reserve if they do not participate in any acreage set-aside program in effect (although an exception was made for ineligible corn producers in 1980).

When the national 5-day, average price farmers receive for a particular grain rises above the release trigger level (price), the USDA declares that the reserve for that particular grain is in release status (Appendix A, Section 8). The CCC, in cooperation with other USDA agencies, monitors farm prices to determine when the reserve should be released (Appendix A, Section 9). A commodity's release means that farmers may pay off their reserve loans and remove or sell the grain from the reserve without penalty, but they are not required to do so. The release of grain from the reserve will likely result in additional quantities of grain coming onto the market. The release trigger price is set as a specified percentage of each grain's national loan rate, with this percentage differing between feed grains and wheat. Reserve loan redemption periods remain in effect for at least 1 month. Hence, any release period would continue at least to the end of the release month and would be subject to review at the end of the following month. Storage payments continue until the end of the initial review period. If the reserve remains in release, storage payments cease.

Reserve program participants may redeem their reserve loans and take grain out of the reserve before the national farm price reaches the initial redemption (release) level, but in most cases stiff penalties make it impractical.

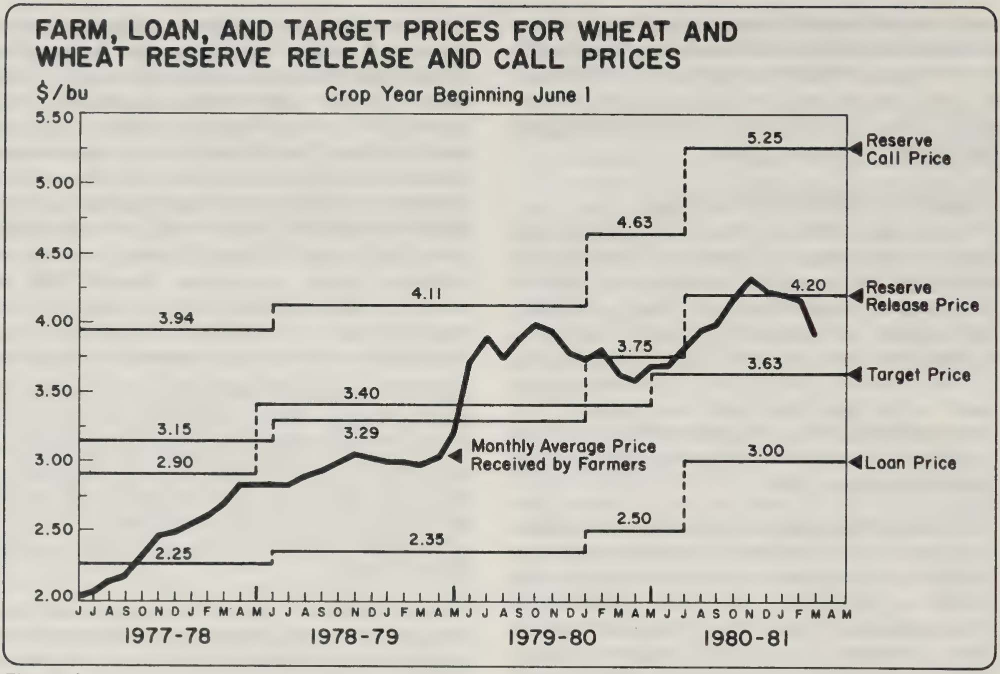

Figure 1

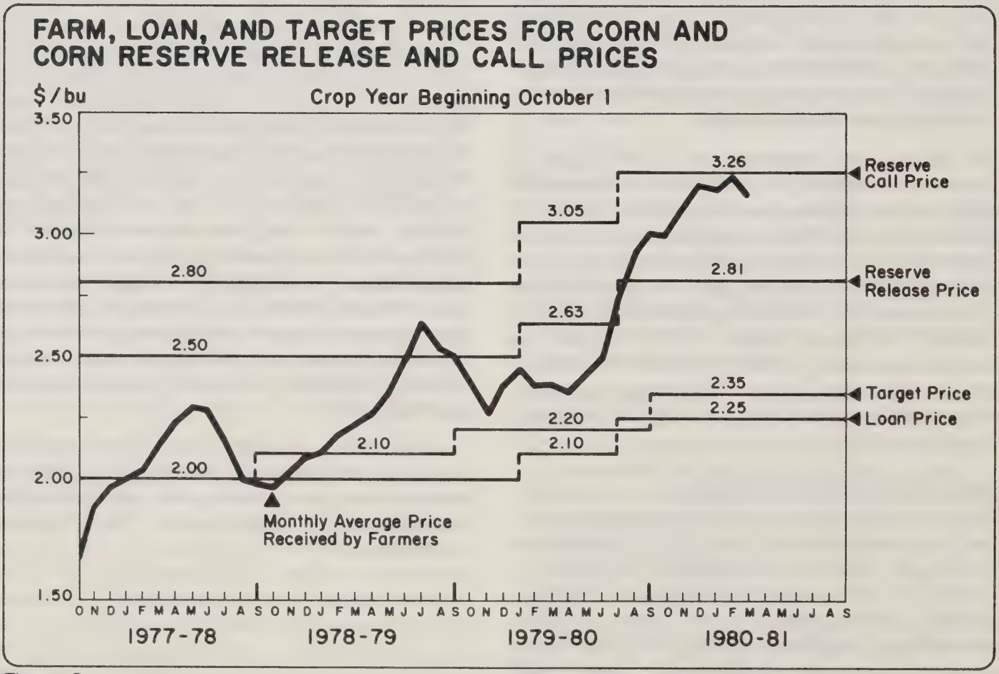

Figure 2

If farm prices continue to rise, the call trigger price level may be reached. The call trigger level is also set as a specified percentage of each grain's national loan rate, but at a higher percentage than for the release level. The percentage also differs between wheat and feed grains. If the national, 5-day average price farmers receive remains above the call trigger level for 5 consecutive market days, the reserve loans are called (Appendix A, Section 10). Producers have to repay their reserve loans within 90 days of notification, thus removing the grain from the reserve as grain cannot remain there unless it is under loan. The notification period can be extended in local areas if the market is congested. Producers are not required to sell their grain, but failure to repay the loan results in forfeiture of the grain to the CCC. The calling of the loans thus forces additional grain onto the market.

If the farm reserve for a particular grain has been placed in call status, then that reserve is deemed to have ceased to exist because the action is irreversible. If the market price should subsequently fall below the release price and if it is deemed desirable, a new reserve can be created (Appendix A, Section 11). However, only grain under a CCC loan or which can be placed under a CCC loan can enter the new reserve. Grain can continue to enter the reserve as long as the reserve is not in call status.

The Agriculture Act of 1980 passed in December set higher loan prices for 1980 and 1981 wheat and feed grains placed in the reserve. However, the release and call trigger levels for the reserve will continue to be based on the CCC commodity loan prices. In addition, the act requires the USDA to waive interest on the reserve loans. Previously, the Secretary of Agriculture had waived interest charges on the second and third years of the reserve loans.

SUMMARY

The acreage set-aside and diversion programs are used to adjust wheat and feed grain production if the Secretary of Agriculture determines that future wheat or feed grain supplies will be excessive. These programs are used in conjunction with the more fundamental programs of price and income support. The inducements for producers to voluntarily reduce their planted area of certain crops is the requirement of compliance as a condition for eligibility for loans, payments, and the farm reserve.

The CCC commodity loan program is a market price support mechanism for U.S. wheat and feed grains (Appendix A, Section 12). Producers have the option of repaying the loan with interest and retaining possession of the grain, forfeiting the commodity as payment for the loan, or entering the grain in the farmer-held reserve. In this way the loan rate serves as a floor price for the commodity. Except during the peak of the harvest period in 1977 for wheat and 1977 and 1978 for corn, the national average price farmers received has been above the loan price (Figures 1 and 2). How effective the loan program is as a price support mechanism depends upon the percentage of U.S. farmers who are eligible for CCC loans. In years where there is a set-aside and producer compliance is low, the price-supporting mechanism of the program will not be nearly as effective as in a year when there is no set-aside and all farmers are eligible for CCC loans.

The target price program provides direct farm income support through deficiency payments to farmers. These payments vary inversely with the commodity's market price. Deficiency payments are made when the market price for a specified period in the crop year is below the target price. The payment rate is the difference between the target price and the market price or loan rate, whichever is higher. One feature of farm income support with direct payments is that the commodity's market price is not enhanced by the program, unlike the commodity loan program. The disaster payment program provides income support through payments to producers for low yields or the prevented planting of a crop because of circumstances beyond their control.

The farmer-held reserve program provides a mechanism with which to isolate excess grain supplies from the market. The storage program is accomplished through an extended price support loan program of 3 to 5 years duration, with farmers receiving storage payments on grain placed in the reserve. The release and call trigger levels of the farm reserve act as a buffer against large price changes. When the farm price is below the release level, grain remains in the reserve and is more likely to enter the reserve. When the farm price moves above the release level, the reserve is placed in release status and farmers may remove grain from the reserve, but are not required to do so. Grain is likely to move out of the reserve and onto the market. When the farm price moves above the call level, the reserve is placed in call status. The reserve loans are called and farmers have 90 days from the notification date to redeem their loans. Grain will be forced onto the market to pay off the loans. How much of the reserve grain will move onto the market will depend upon farmers' future price expectations. With prices rising sharply, farmers can be expected to hang onto more of the grain in anticipation of higher prices and vice versa if prices are not expected to rise further.

APPENDIX A

1. The Secretary of Agriculture established the Agricultural Stabilization and Conservation Service (ASCS) in 1961. The ASCS is responsible for (1) commodity support operations through loans to farmers, direct purchases, and direct payments to farmers; (2) administration of the farmer-held grain reserve; (3) production adjustment to balance demand and supply for specified commodities through cropland set-aside and other acreage diversion; (4) management of Commodity Credit Corporation (CCC) inventories; (5) disaster activities to augment feed supplies and emergency conservation assistance; and (6) resource conservation and environmental protection assistance through cost-sharing with farmers and ranchers. The ASCS provides personnel and facilities used in administering CCC programs at the state and local levels.

2. Designated crops include barley, corn, dry edible beans, flax, oats, rice, rye, sorghum, soybeans, sugar beets, sugar cane, sunflowers, upland cotton, and wheat. State ASCS committees may request that other crops be included in the farm's normal crop acreage.

3. The Commodity Credit Corporation (CCC) was established in 1933 to stabilize, support, and protect farm income and prices; to help maintain balanced and adequate supplies of agricultural and other commodities, and help in their orderly distribution. The CCC may also supply materials and facilities required in producing and marketing agricultural commodities. The CCC provides price and income support for wheat and feed grains through commodity loans, purchases in lieu of loans, direct purchases on the open market, and direct payments. The CCC is also authorized to procure agricultural commodities for sale to other government agencies, foreign governments, or international relief agencies to dispose of surplus agricultural commodities, and to assist in the development of new domestic and foreign markets and marketing facilities for agricultural commodities.

4. Most announced loan and purchase levels are national averages and represent the average of all classes and grades produced of the commodity. The national average loan and purchase rates are converted into support prices for grades and qualities at specific locations. Premiums and discounts are established for qualities other than the base quality. These are added to or subtracted from the base level at each location.

5. The parity price is generally that price which will give an agricultural commodity the same purchasing or buying power in terms of the goods and services farmers buy that it had in a specified base period. The specified period is the 1910-14 base period when prices farmers received and paid were considered to be in good balance. Parity prices for individual commodities are based on their most recent 10-year average farm price. Parity prices have several uses in agriculture, the more important of which are to measure the price needed to provide farmers the same purchasing power as in the 1910-14 base period and to help determine support levels.

6. Variable costs include the cost of production items such as seed, fertilizer, pesticides, custom operations, labor, fuel and lubrication, repairs, drying, and interest charges. Machinery ownership costs include expenditures for interest, taxes, insurance, and replacement. Farm overhead includes costs of record keeping, utilities, maintenance, telephone, and other costs that are difficult to allocate to specific farm enterprises. These overhead costs are allocated to individual crops in proportion to the crop's value relative to total value of farm production.

7. The weighted national average price that farmers receive represents the average of all classes and grades of the commodity as sold by all farmers in their local U.S. markets. These prices are determined from a monthly survey of agricultural prices by the Crop Reporting Board. The survey includes prices farmers receive and pay for commodities and services.

8. The determination of the national, 5-day average price that farmers receive for a particular commodity involves an adjustment factor. Since farm prices are not reported daily, a method had to be developed to relate prices to farmers with terminal prices which are reported daily. This relationship was achieved through an adjustment factor which is the difference between the mid-month average price the previous month, reported by the Crop Reporting Board, and the average price of the grain in question in major terminal markets on the business day closest to mid-month, reported by the Agricultural Marketing Service. This adjustment factor, which remains constant for the entire month, is used to adjust the average terminal price

to obtain a farm price. In the case of wheat, a 5-day moving average price using the average price for four terminal markets (Chicago, Kansas City, Minneapolis, and Portland) is calculated daily and then adjusted downwards by the adjustment factor to obtain the national, 5-day average price that farmers receive for wheat. For corn, a 5-day moving average price for five terminal markets (Chicago, Kansas City, Omaha, St. Louis, and Minneapolis) is used and then adjusted downwards by the adjustment factor for corn to obtain the national, 5-day average price farmers receive for corn.

9. Grain in the reserve is deemed to have reached the release level when the national, 5-day average price that farmers receive, calculated by the CCC, equals or exceeds the commodity's release trigger level (price). In addition, prices must not be trending downwards at the time of the release decision. For wheat, the release level is reached when the national, 5-day average farm price equals or exceeds 140 or 150% (depending upon the particular reserve agreement) of the loan rate. For feed grains, the release level is reached when the national, 5-day average price that farmers receive equals or exceeds 125% of the loan rate for the particular feed grain.

10. Grain in the reserve is deemed to have reached the call level when the national, 5-day average price that farmers receive is at or exceeds the commodity's call trigger level (price) for 5 consecutive market days. In addition, prices must not be trending downwards at the time the call decision is made. For wheat, the call level is reached when the national, 5-day average farm price equals or exceeds 175 or 185% (depending upon the particular reserve agreement) of the loan rate. For feed grains, the call level is reached when the national, 5-day average price that farmers receive is at or exceeds 140 or 145% (depending upon the particular reserve agreement) of the loan rate for the particular feed grain.

11. Three separate reserve agreements existed for wheat and feed grains in March 1981.

    a. Reserve I was for grain entered in the farm reserve before January 7, 1980 with release levels for feed grains and wheat of 125 and 140% of the loan rate. The call levels for this particular reserve agreement for feed grains and wheat were 140 and 175% of the loan rate.

    b. Reserve II was for grain entered in the farm reserve between January 7, 1980 and August 24, 1980, with release levels for feed grains and wheat at 125 and 150% of the loan rate. The call levels for this reserve agreement for feed grains and wheat were 145 and 185% of the loan rate.

    c. Reserve III came into effect August 25, 1980 and had the same release levels for feed grains and wheat as Reserve I. The call level of Reserve III for feed grains was the same as for Reserve II at 145% of the loan rate, whereas for wheat it was 175% of the loan rate, the same as for Reserve I. Only food quality wheat can be entered in Reserve III. This restriction did not apply to Reserves I and II. When the grain reserves for various commodities are called they technically cease to exist. As of March 1981, Reserves I, II, and III for corn, oats, and sorghum and Reserve I for barley had been called.

12. The CCC also provides market price support through the purchase of grain under loan from farmers, and direct purchases of grain on the open market. In the case of wheat, these direct market purchases have gone into a new Food Security Reserve, while the direct corn purchases have gone into CCC held stocks. The USDA has adopted a sales policy for these stocks. The secretary has announced that the CCC will not sell grain it owns into the domestic market at a price less than 105% of the highest of any current farmer-held reserve call price, except for the grain for use in the production of gasohol, which may be sold as low as its reserve release price.

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APPENDIX B

TABLE 1. FARM, LOAN, AND TARGET PRICES AND RESERVE RELEASE AND CALL PRICES FOR FEED GRAINS AND WHEAT[a]

Program	1977-78 Crop			1978-79 Crop			1979-80 Crop			1980-81 Crop		
Target price	Target Price	Farm Price	Deficiency Payment	Target Price	Farm Price	Deficiency Payment	Target Price	Farm Price	Deficiency Payment	Target Price	Farm Price	Deficiency Payment
						$/bu						
Corn	2.00	1.91	–	2.10	2.07	.03	2.20	2.37	–	2.35	–[c]	–
Sorghum	2.28	1.70	.38	2.28	1.95	.33	2.34	2.21	.13	2.50	–[c]	–
Barley	2.15	1.65	.50	2.25	1.90	.35	2.40	2.29	.11	2.55	2.59	–
Wheat	2.90[b]	2.13	.65	3.40	2.88	.52	3.40	3.83	–	3.63	3.89	–

Commodity loan	1977-78 Initial Level[d]	1977-78 Revised Level	1978-79 Initial Level	1978-79 Revised Level	1979-80 Initial Level	1979-80 Revised Level	1980-81 Initial Level	1980-81 Revised Level
Corn	1.75	2.00	2.00	2.00	2.00	2.10	2.00	2.25
Sorghum	1.70	1.90	1.90	1.90	1.90	2.00	1.90	2.14
Barley	1.50	1.63	1.63	1.63	1.63	1.71	1.63	1.83
Oats	1.00	1.03	1.03	1.03	1.03	1.08	1.03	1.16
Rye	1.50	1.70	1.70	1.70	1.70	1.79	1.70	1.91
Wheat	2.25	2.25	2.25	2.35	2.35	2.50	2.50	3.00
Soybeans	3.50	3.50	4.50	4.50	4.50	4.50	4.50	5.02

Farmer-held reserve	1977-78 Release Level	1977-78 Call Level	1978-79 Release Level	1978-79 Call Level	1979-80 Release Level	1979-80 Call Level	1980-81 Release Level	1980-81 Call Level
Corn								
Reserve I[e]	2.50	2.80	2.50	2.80	2.63 (2.50)	2.94 (2.80)	2.81	3.15
Reserve II[e]	–	–	–	–	2.63	3.05	2.81	3.26
Reserve III[e]	–	–	–	–	–	–	2.81	3.26
Sorghum								
Reserve I	2.38	2.66	2.38	2.66	2.50 (2.38)	2.80 (2.66)	–	–
Reserve II	–	–	–	–	2.50	2.90	–	–
Reserve III	–	–	–	–	–	–	2.68	3.10
Barley								
Reserve I	2.04	2.28	2.04	2.28	2.14 (2.04)	2.39 (2.28)	–	–
Reserve II	–	–	–	–	2.14	2.48	2.29	2.65
Reserve III	–	–	–	–	–	–	2.29	2.65
Wheat								
Reserve I	3.15	3.94	3.29	4.11	3.50 (3.29)	4.38 (4.11)	4.20	5.25
Reserve II	–	–	–	–	3.75	4.63	4.50	5.55
Reserve III	–	–	–	–	–	–	4.20	5.25

[a] Farm price is the national weighted average price farmers receive in the first 5 months of the crop year for the particular commodity.

[b] For the 1977-78 wheat crop, producers with wheat acreage allotment received a deficiency payment of 65¢/bu on their acreage planted to wheat, whereas on their unplanted acreage allotment they received a deficiency payment of 22¢/bu.

[c] The deficiency payment for 1980-81 corn and sorghum is not determined until early April 1981.

[d] The initial loan levels for the 1977-78 crops are those specified by the Food and Agriculture Act of 1973.

[e] Reserve I consists of grain entered in the farm reserve before January 7, 1980. Reserve II consists of grain entered between January 7, 1980 and August 24, 1980. Reserve III consists of grain entered in the farmer-held reserve since August 25, 1980. The reserve release levels for feed grains and wheat are 125% and 140 or 150% of the loan rate, whereas the reserve call levels for feed grains and wheat are 140 or 145% and 175 or 185% of the loan rate of the particular commodity.

TABLE 2. PRINCIPAL FEATURES OF THE VOLUNTARY FEED GRAIN AND WHEAT PROGRAMS, FOOD AND AGRICULTURE ACT OF 1977 (APPLICABLE TO 1978-81 CROPS)

Item		1978-79 Crop	1979-80 Crop	1980-81 Crop	1981-82 Crop[a]
National program acreage[b] (million acres)	corn	76.2	85.7	81.7	90.1
	sorghum	13.7	15.9	12.3	15.4
	barley	7.5	7.8	8.3	9.7
	wheat	58.8	70.1	75.0	71.0
Normal crop acreage requirement in effect[c]		Yes	Yes	Yes	No
Acreage set-aside required (%)[d]	corn	10	10	–	–
	sorghum	10	10	–	–
	barley	10	20	–	–
	wheat	20	20	–	–
Acreage diversion rate – feed grains (%)[e]	corn	10	10	–	–
	sorghum	10	10	–	–
	barley	10	–	–	–
Diversion payment rate – feed grains (¢/bu)	corn	20	10	–	–
	sorghum	12	10	–	–
	barley	12	–	–	–
Wheat grazing and hay program[f]					
acreage diversion rate		40% or 50 ac	40% or 50 ac	–	–
acreage payment rate		50 ¢/bu or deficiency payment	deficiency payment	–	–
Recommended acreage reduction for target price protection on all acres planted for harvest (%)[g]	corn	5	10	–	–
	sorghum	5	10	–	–
	barley	20	30	–	–
	wheat	20	15	–	–
Income support – target price ($/bu)[h]	corn	2.10	2.20	2.35	2.35
	sorghum	2.28	2.34	2.50	2.50
	barley	2.25	2.40	2.55	2.55
	wheat	3.40	3.40	3.63	3.81
Price support – national average loan price ($/bu)[i]	corn	2.00	2.10	2.25	2.25
	sorghum	1.90	2.00	2.14	2.14
	barley	1.63	1.71	1.83	1.83
	oats	1.03	1.08	1.16	1.16
	rye	1.70	1.79	1.91	1.91
	wheat	2.35	2.50	3.00	3.00
	soybeans	4.50	4.50	5.02	5.02
Payment limits per person ($)[j]		40 000	45 000	50 000	50 000
Disaster payments for prevented plantings or low yields[k]		Yes	Yes	Yes	Yes

– continue –

PRINCIPAL FEATURES OF THE VOLUNTARY FEED GRAIN AND WHEAT PROGRAMS, FOOD AND AGRICULTURE ACT OF 1977 (APPLICABLE TO 1978-81 CROPS), concluded

Item	1978-79 Crop		1979-80 Crop		1980-81 Crop		1981-82 Crop[a]	
Farmer-held grain reserve[l]	Feed grains	Wheat	Feed grains	Wheat	Feed grains	Wheat	Feed grains	Wheat
Release trigger level as percent of loan rate								
Reserve I	125	140	125	140	–	–	–	–
Reserve II	–	–	125	150	125	150	–	–
Reserve III	–	–	–	–	125	140	–	–
Call trigger level as percent of loan rate								
Reserve I	140	175	140	175	–	–	–	–
Reserve II	–	–	145	185	145	185	–	–
Reserve III	–	–	–	–	145	175	–	–

[a]Preliminary.

[b]National program acreages are preliminary for 1980-81 and 1981-82 crops.

[c]All farms have a normal crop acreage computed by the ASCS, based on 1977 plantings of designated crops. For the 1980-81 crops producers needed to stay within their NCA to qualify for the higher target prices. The NCA was removed as a requirement for eligibility for program benefits for 1981-82 crops.

[d]No acreage set-aside required for 1980-81 and 1981-82 feed grain and wheat crops.

[e]No acreage diversion program required for 1980-81 feed grain crops. No paid acreage diversion program announced for 1981-82 crops, but the final decision is not made until the spring of 1981.

[f]Under the wheat grazing and hay program, wheat producers for the 1978-79 crop received either 50 ¢/bu or the deficiency payment, whichever was larger. For the 1979-80 wheat crop they received only the deficiency payment, if one was made. There was no wheat grazing and hay program for the 1980-81 wheat crop. No program was announced for the 1981-82 wheat crop, but the final decision is not made until the spring of 1981.

[g]Participants who voluntarily reduced their current year plantings from the previous year's considered planted acreage by the recommended percentage were eligible for target price protection on their entire acreage planted for harvest. Participants who did not reduce plantings by these percentages were subject to a program allocation factor of between 80 and 100%. Considered planted acreage includes acreage planted for harvest plus set-aside and diverted acreage in the preceding year. For the 1978-79 crops, the reduction was from 1977 planted acreage, whereas for 1979-80 crops the reduction was from 1978 considered planted acreage. For the 1980-81 crops, producers received full target price protection if the acreage planted in 1980 did not exceed the 1979 considered planted acreage. With the removal of the NCA as a requirement for eligibility for program benefits, there are no acreage restrictions for 1981-82 crops.

[h]Whenever there is no acreage set-aside, the target prices are based on the formula set out in the Food and Agriculture Act of 1977. If the set-aside is in effect, then the secretary of agriculture can raise the target prices at his discretion. which he did for the 1978-79 and 1979-80 crops. For the 1980-81 crops the formula target prices per bushel would have been: corn – $2.05, sorghum – $2.45, barley – $2.29, and wheat – $3.08. However, the Agricultural Adjustment Act of 1980 raised the target prices to the levels shown in the table. Target prices for the 1981-82 feed grain crops will be at least the 1980-81 target price levels, while the target price for wheat will be at least $3.81/bu.

[i]The national average loan prices for the 1981-82 crops will be at least at the 1980-81 levels. The Agriculture Act of 1980 set higher loan prices for 1980-81 and 1981-82 feed grains and wheat placed in the farm reserve. The levels per bushel currently in effect for reserve loans are: corn – $2.40, sorghum – $2.28, barley – $1.95, oats – $1.23, and wheat – $3.30. The 1980 act also waived interest charges on reserve loans. The lower loan rates, however, will continue to be used to determine the release and call trigger levels for the farm reserve for the time being.

[j]Does not apply to CCC loans or purchases, prevented planting, and low-yield disaster payments.

[k]The disaster payment program which was originally intended to end with the 1979 crops has been extended to 1980 and 1981 crops. For the 1981 crops the producer has the option of remaining eligible to receive disaster payments and pay the full cost of the crop insurance premium or declaring himself ineligible to receive disaster payments and have the cost of his crop insurance premium reduced 30%.

[l]Reserve I is for grain entered before January 7, 1980. Reserve II is for grain entered between January 7, 1980 and August 24, 1980. Reserve III is for grain entered since August 25, 1980. As of March 1981, Reserves I, II, and III for corn, sorghum, and oats, and Reserve I for barley have been called.

Economic Indicators

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1978 IV	1978 Annual	1979 I	1979 II	1979 III	1979 IV	1979 Annual	1980 I	1980 II	1980 III
Production and income											
1. GNP at market prices[a]	$ mil.	237 968	229 698	247 496	256 256	264 712	272 756	260 305	278 544[b]	282 752[b]	289 436
2. Farm cash receipts, total[d]	$ mil.	3 341.6	11 899.0	3 397.2[b]	3 304.5[b]	3 458.2[b]	3 917.3	14 077.3[b]	3 796.0[b]	3 458.1[b]	4 031.0
3. – total crops[d]	$ mil.	1 248.0	4 986.1[b]	1 454.7[b]	1 212.6[b]	1 480.8[b]	1 774.9[b]	5 923.0[b]	1 829.2[b]	1 353.7[b]	1 744.6
4. – total livestock[d]	$ mil.	1 923.7	6 541.5	1 863.9[b]	1 951.2[b]	1 881.6[b]	2 051.2[b]	7 747.9[b]	1 902.3[b]	1 978.9[b]	2 194.6
5. Net income rec'd by farm operators[a]	$ mil.	3 240.0	3 214.0	3 988.0	4 348.0	3 280.0	4 152.0	3 942.0	3 708.0[b]	3 404.0[b]	3 736.0
Trade											
6. Agricultural exports	$ mil.	1 391.8[b]	4 846.3	1 204.4	1 354.7	1 663.9	1 884.8	6 107.8	1 501.5	2 008.2	2 003.5
7. Agricultural imports	$ mil.	1 104.4	4 015.06	1 129.2	1 181.6	1 129.4	1 240.4	4 680.6	1 158.9	1 256.9	1 173.6
8. Real domestic product, ag[a]	1971=100	111.3[b]	110.1[b]	109.7	104.9	105.5	112.4	108.1	112.8[b]	113.4[b]	111.6
9. Real dom. prod., less ag[a]	1971=100	137.5[b]	135.1[b]	138.3	138.9	140.8	140.4	139.5[b]	140.1[b]	138.8	139.3
Price indexes											
10. Farm input price index	1971=100	209.2	201.1	229.0	233.9	235.6	239.1	234.4	253.7	250.9[b]	258.7
11. – buildings and fencing	1971=100	209.9	201.0	216.1	233.2	229.5	235.3	226.0	235.5	236.4[b]	242.2
12. – machinery & motor veh.	1971=100	182.1	176.2	188.0	191.8	196.2	205.3	193.3	214.2	221.7[b]	226.9
13. – crop production	1971=100	230.2	225.6	238.6	252.5	258.5	266.5	254.0	296.9	309.1[b]	304.2
14. – animal production	1971=100	218.2	201.8	246.8	252.3	249.2	247.8	249.0	252.7	232.8	256.6
15. – hired farm labor	1971=100	225.4	220.4	228.0	232.8	235.7	237.8	233.6	242.1	245.1	249.2
16. – interest	1971=100	284.5	284.5	385.1	385.1	385.1	385.1	385.1	474.7	470.6[b]	450.8
17. Farm prices of ag. prod.[d]	1971=100	221.9[f]	217.6[f]	250.3[f]	250.7[f]	247.7[f]	246.4[f]	298.8[f]	248.7[f]	242.5[f]	263.2[f]
Input and credit											
18. Farm impl. & equip. sales[e]	$ mil.	342.4	1 288.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
19. Employment in agriculture[a]	'000	495.3[b]	473.0	489.0[b]	489.3[b]	475.7[b]	481.0[b]	483.8[b]	490.0[b]	478.0[b]	466.0
20. Av. farm labor rates	$/h	3.84	3.76	3.89	3.95	4.01	4.08	3.98	4.15	4.22	4.24
21. Av. hourly earnings-manuf.	$/h	7.03	6.84	7.19	7.37	7.50	7.68	7.44	7.90	8.06[b]	8.25
22. F.C.C. – gross loan disburs.	$ mil.	121.7	533.6	35.4	174.7	192.4	145.2	547.7	98.5	189.6	139.3
23. CPI – all items	1971=100	180.5	175.2	184.6	189.4	193.1	197.6	191.2	202.0	207.6	213.5
24. – food at home	1971=100	216.4	209.6	228.6[b]	237.9	241.6	243.8	238.0	250.3	258.2	270.3
25. – food away from home	1971=100	207.3	199.3	213.1	220.8	227.3	232.4	223.4	237.1	240.7	246.6
26. Industry selling price index – food & beverage	1971=100	214.3	205.6	225.9	230.1	233.3	237.5	231.7	244.2[b]	247.9[b]	260.5

continue

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1978		1979					1980		
		IV	Annual	I	II	III	IV	Annual	I	II	III
Other indicators											
27. Unemployment rate	%	8.2	8.4	7.9	7.6	7.1	7.3	7.5	7.5[b]	7.6	7.5
28. Exchange rate	$ U.S.	1.18	1.14	1.19	1.16	1.17	1.19	1.17	1.16	1.17	1.16
29. Av. rate on new demand loans	%	12.32	10.18	12.31	12.55	12.81	15.27	13.24	15.35	16.30	12.61
30. Quarterly pop. est.	mil.	23.55	23.48	23.60	23.65	23.09	23.74	23.67	23.81	23.87	23.94

[a] Seasonally adjusted at annual rates.
[b] Revised.
[c] Preliminary.
[d] Excludes Newfoundland.
[e] Excludes repair parts.
[f] Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Marketing and Economics Branch; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

Notes

MARKET OUTLOOK INFORMATION FOR AGRIBUSINESS FIRMS

The following note was prepared for Canadian Farm Economics *by Dr. H.B. Huff, Commodity Markets Analysis Division, Marketing and Economics Branch. It is based on a study by the Lamb, Guay Inc. – Agrodev Group under a contract funded by the Ministry of State for Science and Technology for Food Processing Distribution and Retailing Research.*

Introduction

The agribusiness sector has been the area experiencing the biggest growth in participation in Agriculture Canada's Outlook Program, according to the attendance at the annual Canadian Agricultural Outlook Conference and recipients of *Market Commentaries.*

The firm of Lamb, Guay Inc. – Agrodev Group was contracted to carry out a study to identify ways of improving the effectiveness of Agriculture Canada's Outlook Program for agribusiness firms (i.e., those firms involved in purchasing agricultural commodities or selling production inputs to agricultural producers).

The study was based on questionnaires distributed at the 1979 Outlook Conference, mailed questionnaires, and personal interviews.

Analysis of the conference used input from 93 questionnaires obtained from the first morning session of the conference, 139 questionnaires from the 7 simultaneous afternoon sessions, and 98 questionnaires from the second morning. For the mailed survey, 1000 questionnaires were mailed (500 from the *Market Commentary* mailing list and 500 others), from which 321 replies were received. Twenty-three firms provided information through personal interviews.

General Observations

The study found that there was a growing need and value of information about commodity markets for all types of decision making, arising from the risk and uncertainty due to rapidly changing economic and political factors, such as high inflation rates, fluctuating exchange rates, extreme commodity price variability, and an increasing number of new policy developments. Firms were actively seeking new ways of keeping abreast of this changing environment.

The consultants noted that there was a vast array of market statistics, market news, and analysis available from publications of Agriculture Canada (more than 80), Statistics Canada (over 80), the U.S. government, provincial governments (over 90), trade associations, and private firms. They also pointed out that recipients are sometimes overwhelmed or confused with the vast amount of information and diverse sources.

Following the above observations, the study concluded that the problem was "not the lack of information but the (inadequate) development of (information) delivery systems to disseminate (commodity market) information to potential users ... Agribusiness is not aware of the information available, how to find it and, in many cases, how to handle the volumes of information available even if they did get it" (p. 48-9).

The consultants reviewed emerging communication developments. They noted that there was an increasing amount of information that was available to users via computer terminals on an 'on-line' basis.[1] For example, the Canadian Teledon system could enable users to access a variety of data banks using their television screen for display. They recommended that Agriculture Canada closely monitor these developments and consider their use for disseminating information.

Annual Conference

Comments and suggestions on improving the annual Canadian Agricultural Outlook Conference related to the evaluation of papers, aspects of the physical environment, social activities, and the conference length (a third day was suggested). One of the significant recommendations was to maintain the same types of topics discussed and the amount of time devoted to the conference. Others included restructuring concurrent sessions to enable multiple attendance; more specific analysis and forecasts and a focus on the underlying issues; and much more attention placed on improving the presentations, including better delivery, increased use of audio-visual techniques, etc. Participants wanted more time to discuss the papers, to present other views, and an elaboration of analysis and forecasts. More up-to-date information and longer-term forecasts were requested. Other recommendations included an informal luncheon, regional conferences augmenting the national one, and better international information, especially on the U.S. market.

Many respondents were attending the conference for the first time (40%) and the majority of all attending believed it to be generally satisfactory.

Mailed Survey

The objective of the mailed questionnaires was to obtain details on the information currently received, the perception of its quality, and what additional information was desired.

[1]On-line refers to information stored on computer discs, enabling instant response to a query.

While most respondents acquired a variety of publications, their requests for additional information often indicated a lack of awareness of available information.

A higher percentage received Agriculture Canada publications than those from the USDA but one from the latter (Livestock and Meat Situation) had the highest rating for its analysis and forecasts.

Senior managers indicated that they were more interested in general information, both international and national, and longer-term forecasts. Middle management were more interested in specific commodity information. Marketing managers were more interested in sales volumes and regional information but generally were not specific in their requests. Market researchers sought a great variety of information and may not be aware of what is available. Financial institutions were most concerned with pricing information. Agricultural organizations wanted a variety of information, including international, national, and provincial.

All groups stressed the desire to have more up-to-date information than Agriculture Canada currently provides. Pricing information was generally considered to be the most important to recipients. Generally, the national data were the most important, except to farmers who felt that international data were slightly more important. All groups believed that quarterly forecasts were most important. Most groups preferred a 12-month forecast but farmers and consultants wanted longer-term predictions.

Personal Interviews

The consultants found that Agriculture Canada publications were considered useful as background information but many firms required more detailed and specific information for decision-making. Information provided by Agriculture Canada was most useful to those firms purchasing agricultural commodities; firms selling production inputs required other types of information.

Individuals who were most satisfied with Agriculture Canada information were those requiring general situation and trend information; those less satisfied were involved in a firm's day-to-day operations, especially purchasing.

The consultants discovered that there was a belief that Agriculture Canada's outlook specialists are becoming more isolated from the real world and that their forecasts with policy implications are often restricted.

It was found that there was a greater awareness of information provided by Agriculture Canada at the operating than at the senior management level.

They suggested that more attention placed on the preciseness and conciseness of analysis and forecasts would be an improvement.

Summary and Conclusions

The consultants found that it was generally accepted that Agriculture Canada had well-qualified staff who had good access to information sources and were well placed to provide quality outlook information.

Notwithstanding, it was discovered that people held strong beliefs that outlook specialists were out of touch with their clients, that the outlook program did not have a high enough priority in Agriculture Canada, and that there were organizational constraints preventing the best use of departmental staff and the resources available to them.

The firm recommended that Agriculture Canada evaluate the emerging communications technology, especially with the intent to speed up information dissemination, of which the respondents were highly critical.

The business community in particular felt that regional extensions of the annual conference, perhaps in cooperation with provincial governments, would be useful. This would allow more focus on those commodities of most interest to the region and more discussion time, something widely favored.

The consultants found that there were enough basic data but that Agriculture Canada should place more emphasis on forecasting, particularly long-term. They recommended more emphasis on specific forecasts and the underlying issues.

Finally, they believed that Agriculture Canada should recognize and interact with the target audience that finds its information most useful and then concentrate on the analysis and forecasting of the types of information which these groups find most valuable. They added that a review of the best techniques to disseminate information should also be included.

ENVIRONMENTAL RESOURCES IN CROP PRODUCTION

This note was prepared for CFE by J.A. Dyer, R.B. Stewart, and D.G. Warner of the Crop Production Division, Production Development Directorate, Regional Development and International Affairs Branch.

Introduction

As we head into the 1980s, we cannot help but be aware of the role that environmental factors play in our lives. Every day we are confronted with new facts about the varying weather patterns and changing environment, either modified by nature or by man's interference. This paper discusses the significance of these factors to crop production. It also suggests how understanding their impact could help to shape crop production policy in the 1980s.

Environmental resources are defined here as the contributions of the natural environment to crop growth. Those factors which can be quantified and which have a positive correlation with crop growth rates are considered resources. Typical examples are seasonal rainfall and heat units, length of the growing season, natural soil fertility, and soil water-holding capacity.

In contrast, environmental limitations must also be considered. For our purposes they are those factors which totally or partially limit the production of specific crops or farming operations. They too can be quantified, but their contribution to crop growth is negative. Typical soil limitations are salinity, acidity, profile shallowness, stoniness, rolling topography, high water tables, and poor drainage. Risks associated with weather variability, such as hail, frost, drought, and winterkill are another type of limitation.

Indexes have been derived which integrate several environmental factors into one resource. An example is the number of field workdays which occur in spring (Dyer *et al.* 1978) or fall (Dyer 1980) during critical periods for planting or harvesting. The number of workdays expected at various probability levels can greatly influence the optimum investment in farm machinery. Another is the potential yield estimates for specific crops based on climatic normals (temperature and rainfall) and soil type. Estimates for some major field crops, including wheat, corn, soybeans, potatoes, and faba beans have recently been completed (Dumanski and Stewart 1981 and Stewart 1981).

The environmental characteristics of major importance to crop production in Canada are highly regional. For instance, from east to west there are vast differences in rainfall. There are differences in the weather systems that affect the central and eastern parts of the country and the Prairie Provinces. A mosaic of climates must be dealt with in British Columbia, stemming from the mountain ranges and humid coastal climate. On the west coast, precipitation is high in winter and low in summer, whereas from the Great Lakes eastward it is more evenly distributed throughout the year. Fortunately for the prairies, where annual precipitation is relatively low, most of it falls during the growing season (Chapman and Brown 1966).

Farmers are faced today with another issue – their responsibility to safeguard the environment from pollutants resulting directly and indirectly from their use of the land. Typical items include the residual effects of pesticides, soil erosion, and the contamination of ground water and runoff with excess fertilizers, particularly nitrates and phosphates (Coote 1980). In a sense, such responsibilities may often be a constraint to crop production, since the environmental protection measures can lead to elimination or alteration of practices that are required for high yields. An example would be the creation of government legislation to control the indiscriminate use of commercial fertilizers, pesticides, and herbicides.

In any case, whether the environment is taken as a resource or a limitation, the first step is to quantify the environmental factors relevant to crop production and store this information in retrievable form. The next phase is to analyze these inventories. This can be done either for the general assessment of land capability and value or for land suitability for a specific purpose, such as introducing a new crop in response to a new market opportunity. Flexibility is the key if this analysis is to be useful in planning and policy development. It is the second phase with which this paper is most concerned.

Background

The earliest attempt to determine and classify land resources across Canada began with the soil surveys of the early 1920s. These were greatly expanded under the Agricultural Rehabilitation and Development Act, which in turn led to the Canada Land Inventory (CLI), a federal-provincial cooperative program (Pratt 1965) to categorize soil and compile maps of soil capability and use. This program produced capability maps (1:250 000) for field crops, forestry, recreation, ungulates, and waterfowl for the southern portion of the country. The classifications used were subjective ratings of the capability (quality) of land to sustain the given use over prolonged periods without degradation.

The CLI's objective was to assess land capability for land use policy and program formulation. It was intended for land use planning rather than for land management, and the approach depended on soil classification and mapping and studies of present land use.

Climatic zoning and classification was also an important component of the CLI. The first comprehensive national climate survey was completed for the CLI Report No. 3 (Chapman and Brown 1966). Recently, another series of Canada-wide maps of soil moisture and temperature have been presented in the Agroclimatic Atlas prepared by the Agrometeorologists of Agriculture Canada (O'hara 1978). All of the above activities which the CLI recognizes are ongoing programs in Agriculture Canada's Land Resource Research Institute (LRRI).

In 1978 the Land Evaluation Section was established in the LRRI. Its mandate was to develop procedures for integrating environmental, agronomic, and socioeconomic information for the systematic evaluation of the agricultural potential of Canada's land resources. The agrometeorology section of the LRRI supported this work by assessing (climate based) crop productivity levels and by defining risks associated with weather variability. The land evaluation program has also been supported through contract research funds.

The Research Branch now has many procedures for analyzing environmental factors. These procedures have been used to generate a large quantity of land related information. At the same time, other procedures have been developed which produce information for specific sites, crop types, and management practices. Most notable among these are the weather based computer models which simulate the response of parameters such as soil moisture or crop growth rates to weather events. Various methods of presenting or storing derived data are used, such as maps, tables, and reports. Much emphasis has been put on computer-compatible data base development such as for the Canada Soil Information System (CANSIS) which facilitates efficient storage and quick retrieval. Computerized map storage has become a sophisticated new technology in itself.

Application and interpretation

Between the developers and users of the procedures there is a wide gap. Essentially, two things are missing. The first is the application of procedures to provide relevant information when it's needed. The second is the summarizing and interpretation of information for non-technical or managerial personnel. The latter is critical to effective interdisciplinary studies. Bridging the gap will lead to dealing more effectively with regional differences, since land and climatic factors have more impact on agriculture than demographic differences. The correlation of land potential estimates with the observed land use patterns can lead to improved crop production levels. Armed with more detailed information on land capability, as well as land use, policymakers would be better prepared to decide which crop types, areas, and producers should receive priority for support and development.

To fill this gap the Crop Production Division of the Regional Development and International Affairs Branch (R.D. and I.A.) recently formed the Resources and Environment Unit. It deals with projects related to the use, development, and conservation of land resources. The first task facing the new unit is to assemble some analysis procedures. Although the application methods may have to be developed or refined, emphasis will be on using existing procedures, rather than developing new ones. For weather related decision making the unit will provide agroclimatic indices, derived from historical weather data and climate normals, to meet specific user needs. For instance, a factor which will receive attention by the new unit will be soil moisture. For other types of land based information, such as land features, soil survey descriptions, and land use data, the emphasis will be on the retrieval and summary of data from other sources, particularly those from the LRRI. Generally, the interpretation of existing technology and completed analyses to help develop policy for improved crop production will be emphasized.

A major project of the Resources and Environment Unit will be to investigate the potential for increasing grain and oilseed production in Canada. This stems from the recent Canadian Wheat Board projections calling for increases in export targets of 30 million tonnes by 1985 and 35 million by 1990. In pursuit of this goal, actual production will have to be increased from the current level of 35 to 40 million tonnes to between 50 to 60 million by 1990. Serious questions exist as to whether the Canadian land resource base can reach and sustain production levels of this magnitude. This, and other similar types of problems, are to be considered from the environmental resource point of view. The unit will use generalized crop growth simulation models requiring phenological, climatic, and soil information to estimate grain and oilseed production potentials in the prairies. Their sensitivity to possible environmental changes, including climatic change, weather modification, soil degradation, and land use patterns, will also be investigated.

Summary and conclusions

Environmental impacts can best be understood by considering the different weather and land related factors as quantifiable resources or limitations. These factors can be analyzed either individually or in combination as derived indices, either for general or specific land use questions. The land resource information recognized in the first CLI report is still of interest today. This includes soil survey descriptions and information on land use, land capability, and climatic zones. Although the technology of land resource analysis has progressed rapidly, the basic priorities set by the CLI are still valid. Land resource assessment has had an impact on land use (i.e., land going in or out of agricultural production), as illustrated by land zoning legislation in British Columbia and Quebec. However, many improvements in the information available since the initial CLI report should lead to wider contributions.

Environmental resource assessment has an important role to play in improving crop production through upgrading land use efficiency. This work could help agricultural policymakers cope with their responsibility to environmental protection. These two new roles for environmental resource assessment can only be filled through effective interpretation and use of information such as that provided by the LRRI. The Environment and Resources Unit of R.D. and I.A. can provide this interpretation phase which has previously been missing. The unit can also provide useful feedback to land resource researchers in helping them adapt to their new roles.

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JOINT VENTURE FOR CANFARM

Canfarm Co-operative Services, the farm accounting service, is entering into a joint venture with IST-COPA (L'Industrielle-Services Techniques Inc./Co-operatives Agricoles). A new company has been formed, called Canfarm Inc.

IST-COPA already provides computerized information and management services to cooperatives. It is a company owned by IST, a computer service company, and seven farm cooperatives. IST is a subsidiary of the Industrial Life Insurance Company of Quebec, which is Canadian owned.

Under the joint venture, Canfarm Co-operative Services will license Canfarm Inc. to use its computer software in Canada. The management of Canfarm Inc. has taken immediate steps to make the company financially sound. Several changes will make this possible. The merging of the computer operations of the companies involved in this venture will save costs through more efficient use of equipment. Although the central office will remain in Guelph and reports will continue to be handled there, a reduction in office space will take place as soon as the present lease expires, resulting in more savings.

The new ownership of Canfarm will have many positive results. It will mean that farmers will continue to get the farm accounting and management programs that now exist, and they will be available in either official language to farmers from coast to coast.

The merging of expertise will greatly enhance the operation. IST's experience in the computer field, for example, will assure that Canfarm will be kept in the forefront of any new technology as soon as it becomes available. This includes areas such as terminal data inputs from the offices of local accounting firms across the country.

The new structure also strengthens the very broad farm organization ownership of Canfarm. IST-COPA brings seven new farm cooperatives into Canfarm Inc. Although Canfarm Co-operative Services and IST-COPA will be the only direct shareholders of Canfarm Inc., these two companies include 33 farm organizations and cooperatives in their list of shareholders.

This should help ensure that programs offered by Canfarm continue to respond to the real needs of Canadian farmers.

The immediate reaction to the new company has been very positive from farmers, accounting firms, agribusiness, financial institutions, and shareholders. The prospect of a solid and financially-viable company in the very near future has created a feeling of confidence in Canfarm throughout the agricultural community.

FARMBANK

FARMBANK is a computerized commodity data base maintained by Agriculture Canada's Marketing and Economics Branch. It contains approximately 1000 regional, national, and international food and agriculture data series for prices, production, stocks, consumption, imports, exports for all major grains and livestock products, as well as farm income statistics, retail prices, and general economic data.

FARMBANK data are mainly quarterly, and originate as far back as 1950. They are collected from Agriculture Canada and other Canadian, U.S., and international sources.

FARMBANK is now available on-line for a monthly fee from the Conference Board of Canada and Datacrown Inc. Prospective clients may contact their marketing representatives for more information about the data base and how to access this information.

Publications

Agricultural Finance, 7th edition. Warren F. Lee, Michael D. Boehlje, Aaron G. Nelson, and William G. Murray. 437 pages. *The Iowa State University Press, Ames, Iowa, 1980.*

This review was prepared for Canadian Farm Economics *by W.D. Jones, an economist with the Production Analysis Division, Regional Development and International Affairs Branch.*

The seventh edition of *Agricultural Finance* marks the book's fortieth anniversary. Substantially revised and reorganized from the sixth edition, the book consists of an introductory chapter followed by three sections on the principles of agricultural finance, financial management of the farm business, and financial markets and agricultural credit consitutions. It is written as an introductory text at the university undergraduate level and some exposure to basic economic, statistic, and accounting principles is assumed.

The introduction has a useful overview of financial trends in American agriculture, including some projections to 1985 of farm numbers, incomes, asset values, and debt. A number of points regarding the interpretation of financial statistics, which are often overlooked by analysts, are also discussed. For example, the authors caution that aggregate industry data do not reflect the financial situation of individual farm operators, Low industry debt-asset ratios illustrate this point in that these ratios are the combined result of operators with little or no debt and those with extremely high debt loads. A second point was that while farm assets are valued at market prices, comparable data for non-farm industries are generally based on the book value or cost of the assets. This inconsistency makes some farm and non-farm comparisons impractical. Another valid point was the need to consider non-farm income and income from capital gains when analyzing the total financial position of farm operators.

Part I of the book introduces the basic concepts of financial management. The subject of risk is discussed in some detail, differentiating between business risk (variability of net earnings) and financial risk (commitments related to the use of non-equity capital) and introducing such statistical measures as the standard deviation, variance, and coefficient of variation. Treatment of the relationship between leverage and financial risk is particularly well illustrated.

Emphasis in Part I is on the principles of the time value of money. The decision process regarding the allocation of capital between current and future consumption is introduced on a theoretical level using indifference curve analysis and the concepts of utility maximization. The discussion is extended to include the effect of a change in the interest rate as well as lending and borrowing transactions. Following a brief introduction to the mathematics of compounding and discounting with respect to investment, two simple examples are used to illustrate the practical application of the concepts presented. A final chapter is devoted to the problems of evaluating alternative investment opportunities. The payback period, simple rate of return, net percent value (NPV), and internal rate of return (IRR), methods of measuring investment worth, are described. The NPV and IRR methods, which incorporate time value of money concepts, are treated in more detail, including ways to account for the uncertainty of future cash flows and one approach (the weighted cost of equity and debt capital approach) to estimate the cost of capital to an operation, so that this cost may be reflected in the discount rate.

Part II looks at the various aspects of financial management, from resource acquisition to estate planning. The capacity to take on debt commitments for business purposes is examined in terms of the ability of the borrower to withstand financial loss, the marginal returns generated from the use of credit, and the ability to repay the loan. Each of these factors is discussed in a separate chapter using the appropriate financial statement. The balance sheet or net worth statement is used to examine risk-bearing ability, the income or profit and loss statement to examine investment returns, and the cash flow or sources and uses of funds statement to examine loan repayment ability. The analysis of the balance sheet includes discussion of a number of debt-asset ratios commonly used to measure solvency. Similarly, profitability analysis using the income statement is examined through various rates of return ratios that relate expenses and capital investment to income. Cash flow statements are introduced as an aid to preparing budgets or cash flow projections for one or more seasons. A very useful summary, which shows the inter-relationships of the three financial statements is included.

A case study, involving a request for farm credit, illustrates how the information discussed in earlier chapters is used to determine the credit worthiness of a farm operation. Several sources of credit problems, such as inadequate repayment plans and unrealistic price and yield assumptions, are discussed. A separate chapter deals with credit instruments (notes, mortgages, agreements, liens, etc.) and the concomitant legal documentation. The chapter ends with the wise advice that legal counsel be sought in connection with major financial transactions.

The remainder of Part II examines risk management and estate planning. Six types of risk are discussed along with several ways to reduce risk, including a brief description of the practice of hedging on the futures market. Various forms of insurance are outlined with a clear, concise treatment of the different kinds of life insurance policies. The chapters on retirement and estate planning are, of course, written with respect to U.S. tax laws but much of the text has universal application. Of particular value are the simple definitions of terms, such as estates, tenancies, and trusts, which are common to this subject but whose meanings are often unclear.

Part III introduces the money market and discusses the components of monetary and fiscal policy which influence this market. A brief outline of how credit institutions acquire and disburse funds contains a useful summary of institutional loan procedures, from collecting the information, through the analysis and closing of the loan, to the important function of servicing the loan. The remainder of the book describes, in considerable detail, the major sources of credit. Entire chapters are devoted to the commercial banks, the farm credit system, insurance companies, other commercial lenders (merchants, dealers, individuals, etc.), and government lenders (the Farmers Home Administration, the Small Business Administration, and the Commodity Credit Corporation).

In summary, *Agricultural Finance* offers a comprehensive introduction to farm investment and credit that is well organized and easy to read. The use of numerous examples and questions at the end of each chapter (with answers supplied for mathematical problems) add significantly to the value of the book as do the chapter summaries.

A valuable addition to the book would have been a chapter on income tax management. Maximization of after-tax income requires knowledge on which form of business organization to use, which method of accounting, how to handle losses, depreciation and capital gains, and how to take advantage of special tax provisions. These considerations are all part of financial management. While a detailed treatment of this topic would require another book, the concepts could at least have been introduced.

It would also have been useful to include more detail on macro-level financial analysis, i.e., discussions of farm sector financial statements, ratio analysis, and aggregate measures of capital and credit requirements. Such analysis would be useful to financial institutions in general and to agricultural credit policymakers in particular.

Of even greater value would be a Canadian edition of this book which would discuss estate planning and credit institutions in a Canadian context.

Agriculture Products Prices, 2nd edition. William G. Tomek and Kenneth L. Robinson. 367 pages. *Cornell University Press, Ithaca, New York, 1980.*

This review was prepared by S.M.H. Rizvi, an economist with the Food Markets Analysis Division, Marketing and Economics Branch.

In recent times, when inflation seems to have become an unending phenomenon, the importance of a textbook on agricultural prices cannot be overemphasized. Agricultural prices occupy a unique economic and political position in a discussion on inflation, especially because of their direct influence on farm income levels, consumer welfare, and in many countries the amount of export earnings. In Canada and the United States, where agricultural output and the food system account for a large proportion of the Gross National Product, agricultural and food product prices command a high degree of political sensitivity. Along with their importance, the overall process by which agricultural prices are usually determined is highly complicated, embodying the entire spectrum of forces ranging from almost complete government regulation to perhaps the closest approximation of freely competitive market conditions. Thus, an examination of agricultural prices is expected to entail a study of a wide range of models of price determination and of price institutions which Professors Tomek and Robinson have done remarkably well in this book. Despite the subject's difficulty, the authors have exposed the theoretical relationships in such a way that the text can be used effectively by senior undergraduate students and the references to various journal articles by students at the master's level.

The text consists of four sections. The first, entitled "Principles of Price Determination," comprises four chapters and explicitly covers the basic theory involved in the process of agricultural price determination. Chapter 2 reviews somewhat more technical aspects of demand theory and its application to the effective demand for various agricultural products. Chapter 3 becomes relatively more empirical and outlines the relationship underlying the concepts of demand elasticities and related elasticity coefficients. The authors extend their approach of analyzing agricultural prices from the demand side to the supply side in Chapter 4.

On the supply side, Professors Tomek and Robinson base their analysis on supply-price relationships and proceed to expose factors that bring about shifts in the supply curve. Supply relationships for agricultural commodities are usually complex. In the short run, the most important factor determining agricultural production of an individual commodity is the availability of alternatives. The supply relation may be price-elastic for an individual commodity when alternative employment and production opportunities are available. In the long

run, changes in the supply of farm products are determined mainly by shifts in the supply schedule most often associated with improvements in technology and changes in the availability and cost of inputs.

In Chapter 5 the authors discuss the determination of agricultural prices within alternative market structures. Structural characteristics are used as a basis for classifying markets and the authors show how price behavior, in terms of level and frequency of change, varies with the type of market structure. Professors Tomek and Robinson single out for the analysis the case of a purely competitive market on one hand and an absolute monoply on the other. Between these two extremes they discuss the price determination process in cases of monopolistic competition, oligopoly situations (pure oligopoly, differentiated oligopoly, etc.) and a bilateral monopoly situation. In addition to these structural characteristics, the authors indicate that price decisions may also be influenced by other considerations such as durability of the commodity, the adequacy of the grade descriptions, bulkiness relative to value, the ratio of fixed to variable costs in the industry, and the continuity and length of the production process.

Section II, entitled "Price Differences and Variability," contains five chapters dealing with price variations and the linkages among prices at the retail, wholesale, and farm levels. Price differences between those paid by the farmers and those paid by the consumer are commonly called 'marketing margins'. Chapter 6 looks at these differences. The authors note that marketing margins change with changes in factor costs, the efficiency of providing services, and the quantity and quality of services embodied in the final product. The effect of changes in margins on retail and farm prices under purely competitive conditions depends on the relative slopes of demand and supply relations, especially when the source of change is in the cost of providing existing services. The authors assert that the influence of variations in margins becomes more complicated when the assumption of price competition is relaxed.

In chapters 7 and 8 the authors analyze the nature and significance of price variations based on quality and on regional and locational differences. The variations based on quality are usually referred to as premiums or discounts and will likely change through time. Price differences based on variations in the location are explained in chapter 7 through the well-known 'spatial price equilibrium model'. This model provides a convenient analytical framework which may be used to determine the indirect as well as direct effects of production changes in one or more regions on the volume and direction of trade. In such an analysis it is customary to use transfer costs between regions, provided that competitive conditions prevail. For a more rigorous treatment of the spatial equilibrium model, the authors have provided a brief appendix at the end of chapter 8.

Chapter 9 presents models explaining the process of price determination through time. This temporal aspect of price behavior for agricultural products is especially crucial because either seasonal, year-to-year, or cyclical changes are a common phenomenon for almost all agricultural products. The authors sum up the nature of factors contributing to the temporal price variability in terms of three broad categories. One is the biological nature of the production process, the other is related to the prevalence of the lagged response relationship in agriculture, and the third is the price inelasticity in both supply and demand. A sophisticated treatment of an elementary cobweb model for the explanation of cyclical price-quantity paths makes the discussion on temporal price changes more satisfying at the end of chapter 9.

After dealing with the factors that determine the price behavior of individual agricultural commodities, the authors allocate chapter 10 to the examination of the causes and economic consequences of changes in the general level of agricultural prices and more importantly, the relationship between average farm and non-farm prices. The authors recognize two features of general price movements – persistent trends (inflation and deflation) and instability. In years to come the authors assert that both inflation and instability will probably persist. Tools of measuring price movement are also discussed in this chapter.

Section III, entitled "Pricing Institutions," is an important one as the role of institutions in the determination of agricultural prices has become increasingly evident during the past three decades. Chapter 11, dealing with the mechanism for discovering farm prices, provides an interesting reading about practices such as informal negotiations, trading or organized exchanges or auctions, pricing formulas, and cooperative bargainings. The authors recognize the shortage of empirical information on this subject which makes the proposition of evaluating the impact of these pricing mechanisms and shift to other kinds difficult. In chapter 12, however, they take up one pricing mechanism, i.e., commodity futures markets, and show how cash and futures prices are actually influenced by changes in expected economic conditions.

The analysis on futures markets is extended into chapter 13 in which the authors turn to a discussion of the functions of a futures market. They recognize that the most general function of the futures markets is to facilitate various types of resource allocations through hedging and through the provision of forward prices. Professors Tomek and Robinson conclude this chapter with a brief exposition of the practices of price

manipulations, regulations, and biases which lead to the failure of some agricultural markets.

Chapter 14, "Government Intervention in Pricing Farm Products," is important because political considerations invariably play a dominant role in farm product pricing in many countries. The role of agricultural economists in this area is to point out which groups will likely gain or lose if a particular policy is adopted. The authors illustrate how principles of economics and a knowledge of demand and supply relationships (elasticities) can be used for forecasting the implications of alternative policies on such variables as the level and stability of farm prices and incomes, consumer prices, the magnitude of surpluses or deficits, the volume of imports, and government costs.

In section IV the authors provide a simplified recipe of various mathematical techniques used in price analysis. Chapter 15 outlines the formulation of models to study the behavior of agricultural product prices and related variables and chapter 16 the use and appraisal of the results of quantitative price analyses. To facilitate senior university students, Professors Tomek and Robinson have provided sufficient discussion of model building to show how the economic principles outlined in previous sections can be juxtaposed with quantitative methods to ultimately generate meaningful, empirical results.

This text presents descriptive and technical information on agricultural marketing and prices useful to third and fourth year students in the departments of agricultural economics across Canada and the United States. Although there are other good texts available in this area, this volume makes an effective contribution to the development of the professional literature.

The following five publications are available free from the Publications Manager, Regional Development and International Affairs Branch, Agriculture Canada, Room E-132, Sir John Carling Building, Ottawa, Ontario K1A 0C5.

Food Market Commentary. Cat. No. A80-751/Vol. 3 No. 1, March 1981.

Handbook of Food Expenditures, Prices and Consumption. November 1980, 290 pp.

Handbook of Food Expenditures, Prices and Consumption – Supplement. January 1981, 168 pp.

Handbook of the Food Processing, Distribution, and Retailing Sectors. Saiyed H. Rizvi, Publication No. 81/1, bilingual, March 1981, 260 pp.

Market Commentary – Proceedings of the Canadian Agricultural Outlook Conference. December 1980, 138 pp.

The following four publications are available free from the Economic Council of Canada, P.O. Box 527, Ottawa, Ontario K1P 5V6.

An Analysis of the Effects of Government Regulations on the Canadian Vegetable Processing Industry. Robert G. Shapiro and David R. Hughes – Broadwith, Hughes & Associates, Ltd., Working Paper No. 11, November 1980, 142 pp.

Employment, Investment, and Consumption in the Canadian Provinces. Tim Hazledine, Baxter MacDonald, and Sandy Maroz, Discussion Paper No. 181, October 1980, 90 pp.

Land Use Control Legislation in the United States – A Survey and Synthesis. J.H. Seeling, Michael Goldberg, and Peter Harwook – Urban Research Group Ltd., Working Paper No. 9, November 1980, 118 pp.

Some Economic Aspects of Internal Migration: Newfoundland's Case, Denis Gauthier, Discussion Paper No. 178, October 1980, 52 pp.

The following three publications are available free from the Institute for Economic Research, Queen's University, Kingston, Ontario K7L 3N6.

A "Reciprocal Dumping" Model of International Trade. James Brander, November 1980, 15 pp.

Some Non-Nested Hypothesis Tests and the Relations Among Them. James H. MacKinnon, November 1980, 41 pp.

Two Notes: 1. On User Solution Strategy for Mixed – Integer Linear Programming Models. 2. On the Solution of Spatial Price and Allocation Models. John Rowse, November 1980, 41 pp.

The following two publications are available from the School of Business Administration and Economics, Simon Fraser University, Burnaby, British Columbia.

An Econometric Demand Model for Canadian Salmon. D. Devaretz, Discussion Paper No. 80-01-2, February 1980, 48 pp.

Two Problems with Keynisian Open Models. Discussion Paper 80-01-1, 1980, 8 pp.

The following two publications are available free from the Canadian Federation of Agriculture, 111 Sparks St., Ottawa, Ontario.

How Farmers Market Eggs in Canada. October 1980, 28 pp.

Marketing Turkey in Canada. April 1980, 32 pp.

Developments Abroad and the Domestic Economy, Volumes 1 and 2. Ontario Economic Council, 1980, 171 pp. and 136 pp. *Available for $10.00 the set from the Publications Centre, 880 Bay St., Toronto, Ontario M7A 1N8.*

An Econometric Model of Soviet and Eastern European Foreign Trade. Jan Vanous, Discussion Paper No. 80-30, August 1980, 88 pp. *Available from the Department of Economics, University of British Columbia, 997-1873 East Mall, Vancouver, British Columbia V6T 1Y2.*

The Economics of the International Stockholding of Wheat. Daniel T. Morrow, September 1980, 46 pp. *Available free from the International Food Policy Research Institute, 1776 Massachusetts Ave N.W., Washington, D.C. 20036.*

Economics Information, "A Survey of Custom Farmwork Rates Charged in Ontario, 1980." G.A. Fisher, January 1981, 22 p. *Available free from the Economics Branch, Ontario Ministry of Agriculture and Food, Legislative Buildings, Queen's Park, Toronto, Ont. M7A 1B6.*

Farm Credit in the Canadian Financial System. 1980, 39 pp. *Available free from the Farm Credit Corporation, 2255 Carling Ave., Ottawa, Ontario K2A 3W9.*

Farm-Scale Production and Use of Fuel Alcohol – Opportunities and Problems. 1980, 10 pp. *Available free from Information Services, Agriculture Canada, Ottawa, Ont. K1A 0C7.*

The Impact of Marketing Boards on Agribusiness: The Case of the Ontario Broiler Industry. Thomas F. Funk and Martin T. Rice, August 1979, 107 pp. *Available from the University of Guelph, Guelph, Ontario N1G 2W1.*

Land Use in Canada. January 1980, 51 pp. *Available free from the Lands Directorate, Environment Canada, 20th Floor, Place Vincent Massey, 351 St. Joseph Blvd., Hull, Quebec K1A 0E7.*

Multiply Your Money – A Beginners Guide to Commodity Speculation. Merrill Uster *et al.*; 1979, 207 pp. *Available for U.S. $13.95 from Concensus Bookshelf, 30 West Pershing Rd., Kansas City, Missouri 64108.*

The National Energy Program 1980. 148 pp. *Available free from Energy, Mines and Resources Canada, 580 Booth St., Ottawa, Ontario K1A 0E4.*

Planning the Development of a Fertilizer Industry. Travis Hignett, 1980, 4 pp. *Available free from the International Agricultural Development Service, 1133 Ave. of the Americas, New York, New York 10036.*

The Potential for Growth of Consumer Cooperatives – A Comparative Analysis. Bruce F. Hall and Lana L. Hall, A.E. Res. 80-28, November 1980, 23 pp. *Available from Cornell University, Ithaca, New York 14853.*

Two Canadian Investment Outlook Surveys: An Overview and a Review. Brian O'Reilly, Technical Report No. 21, November 1980, 82 pp. *Available free from the Bank of Canada, 234 Wellington St., Ottawa, Ontario K1A 0G9.*

In Reply

We appreciate your letters and comments on articles in Canadian Farm Economics. *When forwarding your 'In Reply', or letter, please indicate if we may publish your comments in a subsequent issue.*

The article by J.A. McIsaac and James Lovering in our October issue, "A Model for Estimating Silo Losses and Costs," proved to be very popular. J.G. Young, agricultural representative, P.O. Box 503, Emro, Ontario P0W 1E0, wrote that "This is the first time I have seen the link between silo losses and capital expenses related so well." He was interested in knowing what effect the use of formic acid has on concrete silos and unloading equipment. Mr. Young found the entire October issue to be very useful.

E. Vandevelde, farmer, P.O. Box 48, Mariapolis, Manitoba, also liked the McIsaac and Lovering article. He said that it was "very important because of the high costs involved in putting up the 'Harvestore' type tower silos. These are the answers we're looking for". Mr. Vandvelde went on to say that "The articles in this issue (October) pertained directly to the farming operation I'm engaged in. I found them most interesting and useful."

Allan Spicer, student, P.O. Box 179, Pt. Burwell, Ontario N0J 1T0, said that "The Economics of Oat Production in the Prairie Provinces" by B.H. Sonntag and N.D. Ketilson in the October issue contained material pertinent to a thesis he is doing for an O.D.A. diploma course in agriculture that he is taking at the University of Guelph.

IN REPLY TO AUTHORS AND EDITORS REGARDING VOL. 16, NO. 1, 1981

CANADIAN FARM ECONOMICS

I have read	*and on a scale of 0 to 10, found it* *not useful*		*very useful*
J. Lovering and J.A. McIsaac	0	5	10
J.A. Dyer, J. Girt, and S.C. Lok	0	5	10
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HON. EUGENE WHELAN, MINISTER
GAÉTAN LUSSIER, DEPUTY MINISTER

Demand trends in Canada's mushroom industry

This article analyzes the markets for fresh and processed Canadian mushrooms and makes recommendations on how the industry could expand. The authors describe the national markets, analyze their growth trends, and make an econometric projection of overall expansion in demand. Individual regional markets were investigated to determine the best geographical location for future production. The authors concluded that there may be potential for expansion in the fresh mushroom industry in certain areas of western Canada and the Maritimes. Expansion in the processed market will depend on the marketing effort and tariff policy.

E.R. Pidgeon and R.W. Anderson

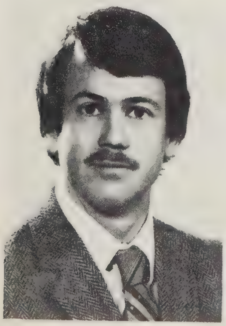
INTRODUCTION

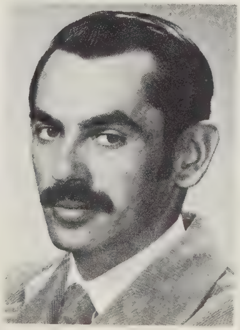
Within the past decade Canada's mushroom industry has grown substantially. The total value of fresh and processed mushrooms increased from $13.1 to $54.1 million between 1970 and 1979 (Table 1). In 1979 it was the third most valuable vegetable crop in Canada, employing over 1500 full-time and 500 temporary staff.[1] From 1970 to 1979, total mushroom production increased from 11.7 to 25.0 million kg (Table 1). Some large, technically advanced operations have recently been established in Quebec, Ontario, and the West. They could increase overall production in 1981 to 35.0 million kg.

[1] Statistics Canada, "Canadian Mushroom Growers' Survey," Cat. No. 22-003.

Dr. E.R. Pidgeon is an economist with the Horticulture Unit, Commodity Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada, Ottawa.

Dr. R.W. Anderson is Head, Horticulture Unit, Commodity Markets Analysis Division, Marketing and Economics Branch, Agriculture Canada, Ottawa.





The demand for mushrooms to date has been fueled by increasing consumer incomes, growing popularity of European dishes such as pizzas, and increasing acceptance of mushrooms in salads and as an hors d'oeuvre. Some are concerned that the future increase in demand will not keep pace with supply increases. If it doesn't there may be downward pressure on prices and industry adjustments. Mushrooms are grown indoors on a year-round basis and capital requirements are substantial. Mushrooms require relatively strict environmental control; thus their production is relatively energy intensive. As capital and energy costs have both increased recently, mushroom growers require buoyant price levels to ensure the viability of the industry.

This article reviews recent changes in the industry with specific emphasis on those aspects of the Canadian mushroom market which are relevant in projecting future demand. This should be useful in determining the rate of expansion which the Canadian mushroom industry can sustain in the future.

Mushrooms are usually sold fresh, canned, or as a component of further processed products such as soup, frozen pizzas, and sauces. They are consumed in households, hotels, restaurants, and institutions. Each of these markets has different demand and supply characteristics and warrants separate analysis.

Consumers prefer fresh mushrooms to canned. As fresh mushrooms have a relatively short shelf life and bruise easily in transport, producers must be located close to their markets. Mushroom producers are presently concentrated in the Vancouver, Toronto, and Montreal areas (Figure 1).

About 80 percent of fresh mushrooms are purchased at the retail level, while the remaining 20 percent are consumed in food products offered by the hotel, restaurant, and institutional trade. Most of the annual 10 percent increase in overall consumption during the past decade occurred at the retail level (Table 2). Much of this expansion in retail demand is due to increases in the number of grocery stores selling fresh mushrooms. Future expansion of demand may depend on the number of stores which does not carry the product but could later on.

A second factor governing demand will be the tendency of consumers to use more mushrooms as complements to meat dishes and salads. As per capita incomes increase, there may be a trend for a higher proportion of the population to consume dishes with mushrooms.

Another factor in the growing use of fresh mushrooms is their quality, appearance, and price competitiveness

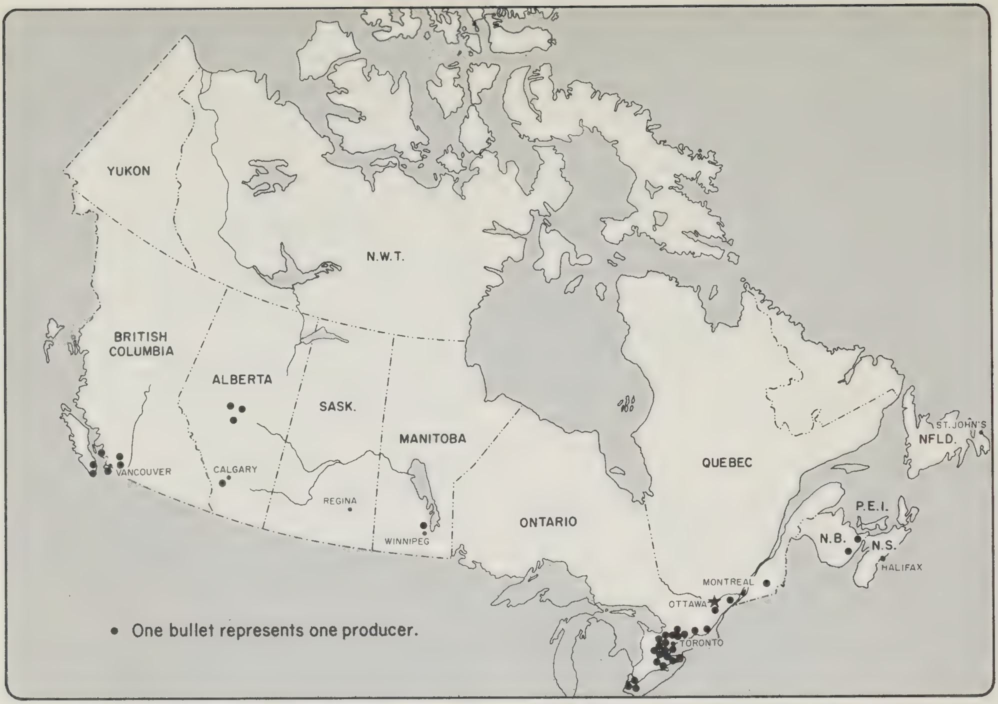


Figure 1. The location of mushroom production in Canada

with substitutes, such as canned. Imports of fresh mushrooms have not been particularly significant, thus there is little potential to increase sales of domestic product through import replacement (Table 1).

In the hotel, restaurant, and institution trade, an expansion in mushroom demand will depend on the demand for items which incorporate mushrooms, such as pizzas, spaghetti sauce, omelets, and crepes. It will also be affected by new products such as 'mushroom burgers'. If more restaurants offer mushrooms in salad bars, then demand would increase as salad bars gained in popularity. Furthermore, the restaurant trade could cause a spillover on retail sales by introducing consumers to ways of consuming mushrooms which they may adopt at home.

Per capita disappearance of canned mushrooms increased as strongly as that of fresh product in the past decade (Table 2). This increase, however, has been almost totally filled by imports. For the last few years, imported canned mushrooms have dominated over 80 percent of the market (Table 1). The market for processed domestic mushrooms may be increased by either expanding the overall demand or by substituting for imports.

It may be possible to regain a higher proportion of the processed market at the retail and restaurant level by decreasing the domestic price relative to imports or by a stronger marketing effort.

Imports of processed mushrooms originate primarily in the Pacific Rim countries where labor costs are a fraction of those in Canada. As labor accounts for a very high proportion of mushroom costs, these countries enjoy cost advantages over domestic producers even when the additional shipping expense is considered. Several factors could make the Canadian product more competitive. Higher shipping costs due to energy price rises, and increasing labor costs in Pacific Rim countries because of their rapid economic development may reduce the cost advantage that imports enjoy. Tariff increases on processed mushrooms in 1979 from 12.5 to 20 percent reduce the price advantage of processed product even further. In addition, it may be possible for domestic producers to reduce their higher labor expenses by mechanizing their harvest operation. Technical developments are being made in mechanically harvesting mushrooms for processing grown under the Dutch system.

TABLE 1. FRESH AND PROCESSED MUSHROOM PRODUCTION VALUES, 1970-79

Year	Fresh			Processed		
	Value of Domestic Production[a]	Domestic Production[b]	Import Share of Disappearance[b]	Value of Domestic Production[a]	Domestic Production[b]	Import Share of Disappearance[b]
	$'000	'000 kg	%	$'000	'000 kg	%
1970	6 850	5 525	14.6	6 327	6 236	33.7
1971	8 444	6 337	5.6	8 473	8 285	48.7
1972	10 586	8 043	2.9	9 725	10 191	56.7
1973	12 360	8 992	10.8	9 326	9 206	50.2
1974	13 354	9 035	27.1	8 755	8 456	62.4
1975	18 741	10 775	10.6	9 326	8 523	62.4
1976	22 977	12 794	3.6	8 128	7 066	68.4
1977	28 291	14 099	2.3	8 999	6 834	84.1
1978	35 798	17 153	1.5	9 311	6 543	80.8
1979	43 215	19 643	5.4	10 897	6 362	85.3

[a]Source: Statistics Canada, "Canadian Mushroom Growers' Survey," Cat. No. 22-003.
[b]Source: Statistics Canada, "Apparent Per Capita Food Consumption in Canada," Cat. No. 32-320.

Canadian mushroom producers may be experiencing a disadvantage in marketing processed product, since much of it is produced from a number of firms each canning a relatively low volume. Much of the processed market is supplied by those who are primarily oriented towards the fresh market and who regard processing as an outlet for surplus. Several years ago, some firms enjoyed the advantage of a nationally recognized product, but inexpensive imports in the 1970s severely encroached upon their market. Only a few firms now have the scale of operations and marketing effort necessary to compete with canned imports. Perhaps the Canadian industry would benefit from the concentration of distribution and marketing of processed mushrooms. A few larger corporations would probably be able to offer the continuity of supply that retail stores require. These firms would be capable of developing brand loyalties through advertising and promotion.

The second principal outlet for frozen or canned mushrooms is the 'further processed' industry, which has grown considerably in the past decade. Demand for items such as frozen pizzas, which use considerable quantities of mushroom, has increased significantly. Unfortunately, there are not enough data on mushrooms used in this sector to do a proper analysis.

TABLE 2. PER CAPITA MUSHROOM CONSUMPTION

Year	Fresh		Canned[a]	
	Apparent Total Consumption[a]	Estimated Home Consumption[b]	Apparent Total	Estimated Home Consumption
	kg/capita			
1970	0.33	–	0.45	–
1971	0.35	–	0.66	–
1972	0.47	–	0.94	–
1973	0.56	–	0.79	–
1974	0.46	0.36	0.96	–
1975	0.53	–	0.97	–
1976	0.58	0.50	0.86	–
1977	0.64	–	1.23	–
1978	0.74	0.65	1.22	0.68
1979	0.83	–	1.67	–

[a]Source: Statistics Canada, "Apparent Per Capita Food Consumption in Canada," Cat. No. 32-336. (This is calculated without figures for changes in imported product stocks. Consequently, actual year-to-year changes may be incorrect.)
[b]Source: Statistics Canada, "Urban Family Food Expenditure," Cat. No. 62-548.

DEMAND PROJECTIONS

There is concern that the rate of supply expansion might exceed that which the market can absorb at present price levels. To estimate the optimal expansion rate for the next decade, the remainder of this paper focuses on projections for the national demand and the demand for specific regions for both fresh and processed mushrooms.

NATIONAL

The quantity of mushrooms in demand nationally for any year may depend on price, time trend, consumer income, or the quantities of food consumed which use mushrooms as a complement. If it is possible to statistically determine the relationship between these factors and mushroom consumption, and if it is possible to project future values of these factors, then we can estimate future mushroom consumption.

We used econometrics to quantify the relationship between consumption and the factors under consideration. As consumption of both forms of mushroom exhibited very strong time trends (Table 2), the only factors which were statistically significant were those which also had strong trend components. It appeared that consumer acceptance over time was the dominant influence.

The two best equations are as follows:

$$(\text{fresh}) = \underset{}{0.173} + \underset{(12.04)}{0.050}\ (\text{time}) \qquad R^2 = 0.935$$

$$(\text{processed}) = 0.335 + \underset{(6.49)}{0.077}\ (\text{time}) + \underset{(2.80)}{0.413}\ (\text{D79}) \qquad R^2 = 0.907$$

(t values are listed in parentheses beneath the coefficients)

where:

(fresh) = per capita domestic consumption of fresh mushrooms in kilograms per capita;

(processed) = per capita domestic consumption of processed mushrooms in kilograms per capita;

(time) = a variable which has the value of 1 for 1968, 2 for 1969, etc; and

(D79) = a dummy variable to remove possible data inaccuracies from poor estimates of the 1979 processed mushroom consumption.

We used the above equations to project the per capita fresh and processed mushroom consumption for the next decade. According to those projections, the average annual rate of increase for per capita consumption of both forms would be about 5 percent per capita. If population increases at about 1 percent, the overall expansion rate for both forms will be about 6 percent. This expansion rate of demand is significantly less than recent supply increases. It may not be possible for the market to absorb such rates of increase if they are sustained for several years.

REGIONAL

There may be significant differences in consumption patterns in rural and urban areas and among regions. If these consumption differences cannot be explained by differences in income and consumption of complementary goods then they may be due to variance in product availability. Producers could conceivably exploit those markets which have lower than average consumption simply by making the product more available.

In 1969, in virtually all regions of Canada, the highest home consumption of fresh mushrooms was in the larger urban centers. Smaller urban centers and rural areas had progressively smaller consumption rates (Table 3). This sort of consumption pattern probably still exists. Some of the differences may be accounted for by a larger ethnic component in the urban centers, or a higher percentage of people preferring the more 'sophisticated' cuisine which uses more mushrooms. Still, there are rather marked differences between the urban and rural market which indicate that there is some potential for market expansion in the rural areas.

Within the urban areas there are significant differences in the consumption of both fresh and processed mushrooms, depending on the region of the country. A 1978 Statistics Canada household consumption survey indicated that there are significantly higher consumption patterns in Quebec, Ontario, and British Columbia (Table 4). These correspond to the areas in which the largest number of producers are located (Figure 1). Conversely, consumption of canned mushrooms is almost twice as high in the Prairie Provinces as in British Columbia and central Canada.

Several provincial characteristics influence demand (Table 4), including disposable income and home consumption of complementary foods such as beef, loin cuts, tomatoes, and lettuce. For this analysis we assumed that tastes are generally uniform across the country. Consequently, a region which exhibits the same degree of income and consumption of complementary goods will be assumed to also have the same demand for fresh mushrooms. If it does not, then it is probably due more to a product shortage than a deficient demand.

TABLE 3. COMPARISON OF URBAN AND RURAL CONSUMPTION OF FRESH MUSHROOMS, 1969

Region	All Classes	All Urban Centers	Urban Center > 30 000 People	Small Urban Center	Rural Area
			g/person/yr		
Canada	141	191	191	95	48
Atlantic Provinces	45	73	118	23	23
Quebec	164	213	213	141	23
Ontario	164	191	213	73	73
Prairie Provinces	95	118	118	95	45
British Columbia	191	191	191	236	141

Source: Statistics Canada, "Family Food Expenditure in Canada," Cat. No. 62-351. (Canned mushrooms were not included in the survey.)

The most important factor affecting fresh mushroom consumption is income. Econometric analysis of the effect of income in the last decade yielded statistically significant results:

$$\text{per capita fresh consumption} = -0.197 + \underset{(9.58)}{0.945} \ln \text{ per capita disposable income} \quad R^2 = .90$$

From this equation we estimated that a 1 percent decrease in income could cause a 0.86 percent decrease in quantity demanded. As a result, mushroom consumption in a particular region should be somewhat proportional to that region's average income. If a region accounts for a lower proportion of fresh mushroom consumption than the proportion of national income, then it may be due to lack of availability. The Atlantic Provinces' per capita income is approximately 80 percent of central Canada's, yet they experience less than half the rate of fresh consumption. Their total consumption (fresh plus canned), however, appears to be similar to that of the rest of the country. The Prairies have comparable income levels yet exhibit a consump-

TABLE 4. FACTORS WHICH MAY AFFECT THE PROVINCIAL DISTRIBUTION OF MUSHROOM CONSUMPTION

	Nfld.	P.E.I.	N.S.	N.B.	Que.[a]	Ont.[a]	Man.	Sask.[a]	Alta.[a]	B.C.	Canada Average
						kg/person/yr					
1978 fresh mushroom at home consumption[b]	0.00	0.31	0.37	0.15	0.69	0.74	0.32	0.29	0.55	0.89	0.64
1978 canned mushroom at home consumption[b]	0.64	0.75	0.77	0.63	0.60	0.55	1.00	0.96	1.16	0.64	0.65
1978 steak at home consumption[b]	1.94	2.79	2.20	1.48	5.93	2.99	3.26	1.94	3.47	2.07	3.26
1978 tomato at home consumption[b]	3.66	3.55	4.14	2.85	5.98	10.52	5.11	3.94	4.85	4.62	7.11
1978 lettuce at home consumption[b]	1.38	2.31	2.11	1.83	5.10	4.34	3.39	3.19	3.81	4.21	4.29
						$					
1978 per capita disposable income[c]	4446	4778	5364	5025	6024	7148	6385	6308	6891	7157	6555
						no.					
restaurants per million population, 1976[d]	394.5	668.4	654.1	453.3	1134.5	687.9	600.1	625.1	633.3	974.6	811.5

[a]We assumed for these provinces that the provincial average consumption was the average consumption of the cities surveyed in that province weighted according to their population.

[b]Source: Statistics Canada, "Urban Family Food Expenditure, 1978," Cat. No. 62-548.

[c]Source: Statistics Canada, "Provincial Economic Accounts," Cat. No. 13-213.

[d]Source: Statistics Canada, "Food and Beverage Industry Survey, 1976," Cat. No. 63-529.

TABLE 5. AT HOME URBAN FRESH MUSHROOM CONSUMPTION BY PROVINCE

Province	1978	1976	1974	1969
Newfoundland	0.00	0.00	0.08	0.00
Prince Edward Island	0.68	–	–	0.26[a]
Nova Scotia	0.82	0.29	0.44	0.26[a]
New Brunswick	0.32	–	0.18	0.26[a]
Quebec	1.52	1.48	1.23	0.47
Ontario	1.62	1.21	0.94	0.47
Manitoba	0.70	0.63	0.48	0.26[a]
Saskatchewan	0.63	–	0.40	0.26[a]
Alberta	1.22	0.86	0.52	0.26[a]
British Columbia	1.96	1.71	1.29	0.42
Canada	1.41	1.26	0.97	0.31

[a]Regional average.

Sources: Statistics Canada, Cat. Nos. 62-548, 62-545, 62-542, and 62-531; Statistics Canada, "Urban Family Food Expenditure," Cat. No. 32-336.

tion rate for fresh little more than half of that in central Canada. Their total mushroom consumption, like the Atlantic Provinces', is equal to or greater than that of the rest of the country. Alberta, because of a strong demand for canned mushrooms, had the highest total mushroom consumption of any province in 1978.

Quebec's relatively high rate of fresh mushroom consumption may be explained by higher consumption rates of complements such as steak and salad ingredients. Ontario's high consumption may be attributable to a high consumption rate for salad ingredients such as tomatoes and lettuce. The Prairies tend to have a consumption level of steak which is higher than either Ontario's or British Columbia's. Consequently, it appears that the demand for mushrooms as a complement to steak is shown in a higher consumption rate of canned product.

In conclusion, consumption of fresh product is relatively high in central Canada and British Columbia where most of the producers are located. Canned mushroom consumption is higher in the Maritimes and significantly higher on the Prairies. There may be considerable potential for increasing the market for fresh product in the latter areas if local producers can adopt more aggressive marketing practices and persuade consumers to switch from canned to fresh mushrooms.

There appears to be no tendency for consumption to plateau, even in the areas which already have high consumption levels (Table 5). Even if the increase rate in such areas were to decline, there appears to be considerable potential for expansion in regions which have low consumption rates.

The foregoing figures for regional consumption are only for mushrooms consumed at home. There are no figures for institutional and restaurant consumption. As an increasing proportion of food is consumed away from home, it would be instructive to analyze the regional characteristics of this market. As estimated previously, about 15 percent of the demand may be accounted for by restaurants. Quebec, Ontario, British Columbia, and Alberta all have relatively high per capita numbers of restaurants and volumes of business (Table 4). If there is a significant trend towards salad bars and the sale of food containing mushrooms in restaurants, then those latter regions may experience the greatest increase in demand.

SUMMARY

The demand for fresh and processed mushrooms has grown steadily during the past decade. Producers may expect both markets to increase at an average annual rate of about 6 percent. If production increases more quickly than that it may be necessary to decrease prices to increase sales. Alternatively, producers would have to regain some of the market for processed mushrooms now being served by imports. To do this, it may be advisable to develop a few nationally recognized brands, or to redevelop the national prominence that some processors previously enjoyed.

There may be opportunities for fresh mushroom producers in the Maritimes and the Prairies to exploit the large demand for mushrooms which is being supplied by canned product. In addition, smaller producers may have some potential in serving local markets which are not near to the major producing areas.

The role of farm consolidation in Canadian rural population change, 1961-76

During the last 2 decades the Canadian farm population as a proportion of the total rural population has been declining. How low it must go before the further loss of farmers is of little significance for the rural economy, whether the problem which structural change in farming poses for the viability of rural communities is now largely one of the past, and whether the painful adjustment has already occurred to the extent that we need no longer fear the consequences of further farm consolidation are questions which the authors address in this paper.

D. McClatchy and D. Abrahamse

INTRODUCTION[1]

The phenomenon of structural change in the farm sector – to larger and fewer farms – is believed to bring with it both benefits and costs for society as a whole. Benefits are seen to accrue from increased average efficiency in farm production which, for various reasons, is often associated with such change. A rise in production efficiency leads in turn to both higher net farm incomes and lower food prices. On the negative side, we see adjustment problems for the farmers and their families directly involved in the adjustment, particularly those who are displaced from the farming industry. This paper, however, is confined to the assessment of another major perceived social cost of such farm industry adjustment, that is, its indirect effect on the economic viability and quality of life in rural communities.

We have traditionally laid a major part of the blame for the observed demise of certain small rural communities on structural change in the farm sector. This model may be simply exemplified by the amalgamation of two small farms, the owner-operators of which habitually bought the major part of their household and farm supplies locally, into one larger farm with a more business-oriented operator who is prepared to travel 50 miles or more to a larger center for cheaper supplies. Hence, local suppliers lose two customers, and the rural population falls by perhaps two families – one farm family directly, and one other indirectly because of the loss of business and hence employment in the local community.

The magnitude of the exodus from rural areas and its impact on rural communities in North America has been well documented. A paper by Kolb and Day (1950) is an example of many bulletins dealing with this subject which were published by U.S. university agricultural experiment stations during the 1950s. Copp (1964) edited one of several books on the subject, and Flinn and Buttel (1980) provided a useful, up-to-date review article. For Canadian perspectives we have Warrack (1970), Zimmerman and Moneo (1971), Fast (1972), and Meredith (1975).

As long as the economic base of rural communities is agriculture, the foregoing model will probably remain valid. But, at least during the last 2 decades in Canada, the farm population as a proportion of the total rural population has been declining in all provinces.

How low must it go before the further loss of farmers is of little significance for the rural economy? Is the problem which structural change in farming poses for the viability of rural communities now largely a problem of the past for most rural regions. Has the painful adjustment already occurred to the extent that we need no longer fear the consequences of further farm consolidation?

We explored agriculture census, population census, and labor force data by census division for 1961, 1966, 1971, and 1976, to try to discover some broad answers to this sort of question. Since our objective was to arrive

[1] This paper was presented to the Canadian Regional Science Association Conference, Halifax, Nova Scotia, May 22, 1981.

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at a Canada-wide overview, no apology is made for the absence of rigorous statistical analysis. Our work, however, suggests some hypotheses which might benefit from more detailed scrutiny in subsequent studies.

PROCEDURES

The findings of our study are dependent on a few key premises.

Definition of Rural Population

Our definition of rural population, to encompass residents of all towns with up to 10 000 people, departs from the Statistics Canada definition which includes only those residents in small towns and villages with up to 1000 people. We have followed recent studies which have indicated that the characteristics of rural and urban populations meet and overlap in a center of about 8 000 - 10 000 people (Canadian Council on Rural Development 1978). Also important is the concept that major towns (5 000 - 10 000) function as downtowns in rural community systems, and are therefore integral parts of rural areas (Meredith 1975).

For most cities the urban (or non-rural) population in this paper includes the residents of entire Census Metropolitan Areas (CMAs) or Census Agglomerations (CAs), rather than the residents of only the core city. In a few cases the boundary of the CMA or CA coincides with a city's legal boundaries, but in most instances, CA or CMA limits include municipalities adjourning the city. These municipalities often have populations under 10 000. Because the rural population in this study included towns with populations of up to 9 999, we attempted to distinguish between municipalities which were really city suburbs and centers which functioned as downtowns for rural areas.

Adjustments have been made to the published data to ensure consistency across years in classifying the population of centers with close to 10 000 people. For example, Amherst, Nova Scotia, with a population of 9966 in 1971 but of more than 10 000 in other census years, was classified as urban for the entire 15-year period that the study covered. Census figures were also adjusted to keep the boundaries of CMAs and CAs as consistent as possible throughout the period.

We divide the rural population into three mutually exclusive categories:

- farm: all people living on farms,
- non-farm and non-town: all people living in the countryside (but not on farms) or in villages of less than 1000 people (This category corresponds to Statistics Canada's 'Rural Non-Farm'.), and
- rural town: all people living in towns of 1000 to 9999 residents.

Figures 1 and 2 depict and define nine groupings of contiguous census divisions which we are calling rural regions of Canada. These groupings reflect a desire to exclude the peripheries of the largest metropolitan areas. They also reflect the necessity of excluding some rural areas where data lack comparability over time, mainly because of census division boundary changes. (British Columbia is the most notable exclusion on these grounds.) Otherwise, the groupings tend to follow broad natural geographical boundaries with the exception of the prairies, where we considered it desirable to allow for possible influences of economic activity on surrounding rural areas of the major urban centers of Winnipeg and the Calgary-Edmonton corridor. We considered these areas separately from the rest of the rural prairies.

We expected that the regions defined would be comprehensive and different enough to reflect the varied extent to which the populations and prosperities of individual rural regions of Canada depend on the economic base of the farming sector.

Direction of Population Change

A second important underlying premise of this study is that the direction of population change in a rural community is indicative of its social and economic well-being and viability. Hence, we assumed that a declining population is indicative of a deteriorating rural community and vice versa. There may be grounds for questioning this premise depending on the values adopted; however, it appears to enjoy political popularity.

Sectoral Breakdown of the Labor Force

The third critical premise is that a sectoral breakdown of the labor force can be useful in determining the extent to which a given rural community is economically dependent on the farm sector, particularly on the maintenance of the farm sector's structure.

However, there are several problems with this assumption. The labor force includes people looking for work as well as those actually employed (employment data by industry are not available at the census division level). Secondly, in counting numbers of jobs (or workers) no distinction is made between part-time, seasonal, and full-time work. Furthermore, the place of work of rural residents will not always be in a rural area. While we did want to focus on all employment entered into by rural residents and therefore supportive of the rural population, it may be argued that a full-time job located in a rural area will usually have a much stronger multiplier effect, in terms of supporting the rural economy, than a full-time job in an urban area to which the rural resident commutes.

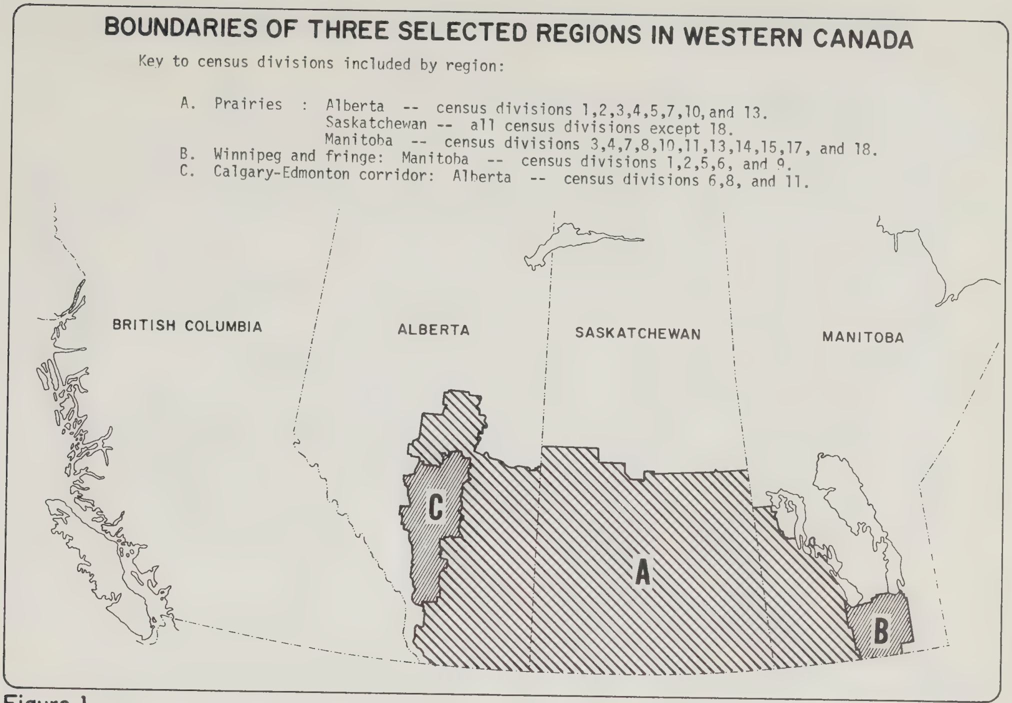

Figure 1.

No attempt was made to objectively assess the impact of these discrepancies. Subjectively, after some enquiries, it was judged that, for the purposes of the broad perspectives which we were seeking, the problems associated with this third premise would not be critical.

Indicators of Farm Sector Structural Change

Finally, changes in farm numbers, in the population living on farms, and in the size of the farm work force were all used as indicative of structural change in the farm sector at different points in this paper. The rather loose substitution of these different concepts is justified because of the close similarity in their respective rates of change over the same period in each region (Table 9).

CHANGES IN RURAL POPULATION COMPONENTS IN NINE RURAL REGIONS, 1961-76

In absolute terms the farm population declined in all nine regions and in all intercensal periods in 1961-76 (Table 1). This was matched for consistency by a population rise in rural towns in all regions and all intercensal periods. Rural non-farm and non-town population rose in all regions during the 1966-71 and 1971-76 periods, but declined in three of the nine regions between 1961 and 1966. Thus, at least in general directional terms, each component showed reasonably consistent change across all regions.

However, the results of all these changes in determining total rural population change show considerable variability between regions (Table 1). To some extent this appears to be due to differences between regions in the magnitude of change in each component (Table 2). And to some extent it reflects different starting points in terms of the composition of the total rural population by major component in 1961 (Table 3).

Total rural population declined between 1961 and 1976 in three of the nine areas. These were Lower St. Lawrence, where the rate of decline was highest; Southeastern Quebec, where the rate of decline was lowest; and the Prairies, where the absolute decline was the most significant. Rates of gain of rural population in the other six regions varied, both among regions and between intercensal periods, with the Calgary-Edmonton corridor and Southeastern Ontario regions showing the highest rates of 15-year gain (Table 2).

BOUNDARIES OF SIX SELECTED REGIONS IN EASTERN CANADA

Key to census divisions included by region:

D. W. Nova Scotia: Annapolis, Antigonish, Colchester, Cumberland, Digby, Hants, Inverness, Kings, Pictou, and Victoria.
E. Prince Edward Island: Kings, Prince, and Queens.
F. Lower St. Lawrence: Bonaventure, Kamouraska, Matane, Matapedia, Rimouski, Rivière-du-Loup, and Témiscouata.
G. S.E. Quebec: Beauce, Bellechasse, Dorchester, Frontenac, L'Islet, Lotbinière, Mégantic, Montmagny, Richmond, Sherbrooke, Stanstead, and Wolfe.
H. S.E. Ontario: Dundas, Frontenac, Grenville, Hastings, Lanark, Leeds, Lennox and Addington, and Prince-Edward.
I. S.W. Ontario: Brant, Bruce, Elgin, Grey, Huron, Kent, Lambton, Middlesex, Oxford, Perth, and Wellington.

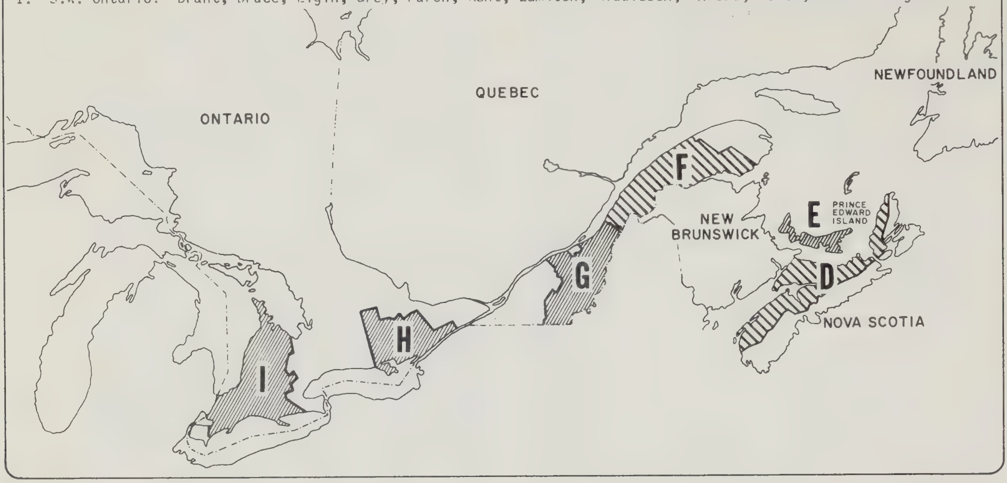

Figure 2.

To summarize, a declining farm population had a direct downward impact on total rural population in all regions; this was countered by increases in the non-farm and non-town and rural town population components. The outcome of these opposing forces, and the importance of farm population decline in determining rural population change, clearly depended on the percentage of the total rural population which the farm population comprised and the farm population's rate of decline.

Neither of these factors on its own can fully explain even the direction, much less the magnitude, of rural population change. For example, in the Lower St. Lawrence the farm population made up 36 percent of the rural population in 1961 – a rural population which showed a 20 percent decline in the next 15 years. On the other hand, Prince Edward Island, Southwestern Ontario, the Winnipeg fringe, and the Calgary-Edmonton corridor all had a higher percentage of their rural populations on farms in 1961 and showed rural population increases. Similarly, Prince Edward Island, Western Nova Scotia, and Southeastern Ontario all showed greater rates of farm population decline than the Prairies, but their rural populations increased while that of the Prairies decreased.

Hence, it appears that factors other than structural change in the farm sector were also helping to determine rural population changes in the 1961-76 period. The total rural population of our nine regions fell 1 percent in each of the two earlier intercensal periods, but rose 4 percent between 1971 and 1976 (Table 4). This, at first sight, suggests that certain of the already observed trends in the sizes of the three components of rural population may themselves be changing, and in particular, that some significant shift in the pattern of change may have occurred in the early 1970s. However, a closer examination leads us to conclude that this is somewhat illusory.

While the rate of decline in the farm population shows signs of being lower during periods of more favorable economic conditions for farming, there is no conclusive evidence that the long-term rate of decline is showing. The 1971-76 decline was 16 percent at the national level, 15 percent for the aggregate of the nine regions (Table 4), and between 6 and 36 percent in individual regions (Table 2). Because the farm population constitutes a declining proportion of the total rural population in all regions, even a constant rate of decline in the former can be expected to have a gradually lower impact (over time) on the latter.

TABLE 1. ABSOLUTE CHANGE IN RURAL POPULATION COMPONENTS IN NINE SELECTED CANADIAN REGIONS, 1961-76

Region	Farm			Rural Non-Farm and Non-Town			Rural Towns			Total Rural		
	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76
Prince Edward Island	− 3 712	− 9 703	− 5 546	+ 4 274	+ 10 480	+ 12 169	+ 2 043	+ 10	+ 381	+ 2 605	+ 787	+ 7 004
Western Nova Scotia	− 7 459	− 13 944	− 3 500	+ 6 036	+ 22 803	+ 20 753	+ 703	+ 2 719	+ 1 747	− 720	+11 578	+ 19 000
Lower St. Lawrence	− 15 244	− 29 181	− 15 134	− 9 388	+ 11 740	+ 5 352	+ 3 072	+ 448	+ 463	−21 560	−16 993	− 9 319
Southeastern Quebec	− 18 723	− 37 652	− 21 072	+ 4 205	+ 30 790	+ 18 075	+10 384	+ 3 122	+ 1 059	− 4 134	− 3 740	− 1 939
Southeastern Ontario	− 3 935	− 13 429	− 5 855	+ 4 413	+ 21 493	+ 23 348	+ 2 661	+ 726	+ 339	+ 3 139	+ 8 790	+ 17 832
Southwestern Ontario	− 9 261	− 27 534	− 16 845	+ 5 925	+ 44 440	+ 43 307	+ 7 300	+ 9 273	+17 819	+ 3 964	+26 179	+ 44 281
Winnipeg fringe	− 6 092	− 9 082	− 6 404	+ 6 344	+ 6 784	+ 12 771	+ 3 423	+ 1 687	+ 3 959	+ 3 675	− 611	+ 10 326
Prairies	− 35 986	− 85 130	− 52 110	−17 249	+ 6 476	+ 23 110	+19 639	+ 6 457	+15 526	−33 596	−72 197	− 13 474
Calgary-Edmonton corridor	− 2 923	− 9 831	− 4 085	− 1 394	+ 21 675	+ 17 956	+ 4 009	+ 9 978	+19 419	− 308	+21 822	+ 33 290
Total	−103 335	−235 486	−130 551	+ 3 166	+176 681	+175 841	+53 234	+34 420	+60 712	−46 935	−24 385	+107 002

Sources: Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-702; Dominion Bureau of Statistics, *1966 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-607; Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-708; *1976 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-802, 92-803, 92-804, 92-805 and 92-806; and Statistics Canada censuses of agriculture for 1961, 1966, 1971, and 1976. Data for 1976, based on the 1971 definition of a census farm, were not published.

TABLE 2. CHANGE IN RURAL POPULATION COMPONENTS IN NINE SELECTED CANADIAN REGIONS, 1961-76

Region	Farm			Rural Non-Farm and Non-Town			Rural Towns			Total Rural		
	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76	1961-66	1966-71	1971-76
						percent						
Prince Edward Island	−11	−31	−26	+18	+27	+25	+14	0	+ 2	+ 3	+ 1	+ 8
Western Nova Scotia	− 2	−41	−17	+ 4	+15	+12	+ 1	+ 5	+ 3	0	+ 5	+ 8
Lower St. Lawrence	−18	−41	−36	− 9	+12	+ 4	+ 4	+ 1	+ 1	− 9	− 8	− 5
Southeastern Quebec	−14	−33	−27	+ 4	+25	+12	+12	+ 3	+ 1	− 1	− 1	0
Southeastern Ontario	− 6	−23	−12	+ 4	+22	+22	+ 8	+ 2	0	+10	+ 5	+10
Southwestern Ontario	− 5	−15	−11	+ 3	+25	+20	+ 5	+ 7	+12	0	+ 5	+ 9
Winnipeg fringe	−10	−16	−14	−16	+15	+25	+13	+ 6	+13	+ 3	0	+ 8
Prairies	− 7	−17	−12	− 5	+ 2	+ 7	+ 9	+ 3	+ 7	− 3	− 7	− 2
Calgary-Edmonton corridor	− 4	−13	− 6	− 3	+43	+25	+10	+22	+35	0	+13	+17
Total	− 8	−21	−15	0	+16	+14	+ 8	+ 5	+ 8	− 2	− 1	+ 4

Sources: Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-702; Dominion Bureau of Statistics, *1966 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-607; Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-708; *1976 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-802, 92-803, 92-804, 92-805, and 92-806; and Statistics Canada censuses of agriculture for 1961, 1966, 1971, and 1976. Data for 1976, based on the 1971 definition of a census farm, were not published.

TABLE 3. COMPOSITION OF RURAL POPULATION BY MAJOR COMPONENT IN NINE SELECTED CANADIAN REGIONS, 1961 AND 1976

Region	1961			1976		
	Farm	Non-Farm and Non-Town	Rural Towns	Farm	Non-Farm and Non-Town	Rural Towns
	percent					
Prince Edward Island	42	41	17	17	65	18
Western Nova Scotia	18	60	22	6	72	21
Lower St. Lawrence	36	45	19	14	61	25
Southeastern Quebec	40	35	25	17	52	31
Southeastern Ontario	26	45	29	14	59	27
Southwestern Ontario	38	35	27	24	47	29
Winnipeg fringe	49	31	21	29	46	25
Prairies	50	31	19	38	36	26
Calgary-Edmonton corridor	46	30	24	27	40	33
Total	41	37	22	25	48	28

Sources: Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-702; Dominion Bureau of Statistics, *1966 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-607; Statistics Canada, *1971 Census of Canada,* Vol. 1, Pt. 1, *Population,* Cat. No. 92-708; *1976 Census of Canada,* Vol. 1, *Population,* Cat. No. 92-802, 92-803, 92-804, 92-805, and 92-806; and Statistics Canada censuses of agriculture for 1961, 1966, 1971, and 1976. Data for 1976, based on the 1971 definition of a census farm, were not published.

There is some indication from the figures in Table 2 of a major change in non-farm and non-town population trends. This change, however, shows up first in the 1966-71 period rather than in the 1971-76 period. With the exception of three regions (Prince Edward Island, the Winnipeg fringe, and the Prairies) a considerable boost in the rate of change of this component in 1966-71 is apparent in comparison with the previous five-year period. The change is most dramatic in the Calgary-Edmonton corridor, where it moved from minus 3 percent to plus 43 percent. Of the three exceptions, Prince Edward Island and the Winnipeg fringe had already showed a high rate of increase of this component in 1961-66, so in these two regions the boost may have come earlier. In the other exception, the Prairies, the same type of change is visible, though it has been more gradual and of weaker magnitude.

With rural towns the pattern is more variable from region to region. This component has grown in the Calgary-Edmonton corridor at an increasing rate (Table 2). In Southwestern Ontario, the Winnipeg fringe, and the Prairies it has been growing even more steadily. In Western Nova Scotia and the Lower St. Lawrence this component is relatively stable, while in Prince Edward Island, Southeastern Quebec, and Southeastern Ontario it appears to have stabilized during the last decade after some growth prior to that.

This quick overview of the components has not revealed an obvious explanation for what appeared to be a significant change in the rate of rural population growth in 1971-76. It rather suggests that a combination of factors has resulted in the 1971-76 period appearing to be more significant than it really is. Little evidence for

TABLE 4. COMPOSITION OF THE RURAL LABOR FORCE BY INDUSTRY GROUPINGS, FOUR SELECTED CANADIAN REGIONS, 1961 AND 1971

Region	Agriculture		Other Primary Industries		Secondary Industries		Tertiary Industries	
	1961	1971	1961	1971	1961	1971	1961	1971
	percent							
Prince Edward Island	33	17	8	6	15	17	44	60
Lower St. Lawrence	25	13	18	10	15	22	43	54
Southwestern Ontario	35	23	1	1	33	37	31	40
Prairies	55	43	2	2	6	8	37	46

Sources: *1961 Census of Canada,* Vol. III, Pt. 2, *Labour Force,* Cat. No. 94-519, 94-520, 94-521 and 94-522; Statistics Canada, *1971 Census of Canada,* Vol. III, Pt. 4, *Industries,* Cat. No. 94-741, 94-744, and 94-745.

TABLE 5. ABSOLUTE AND PERCENT CHANGES IN RURAL LABOR FORCE BY INDUSTRY GROUPINGS, FOUR SELECTED CANADIAN REGIONS, 1961-71

Region	Agriculture		Other Primary Industries		Secondary Industries		Primary and Secondary Industries, Subtotal		Tertiary Industries		Total	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
Prince Edward Island	− 3 334	−37	+ 23	+ 1	+ 2 007	+50	− 1 304	− 8	+ 8 834	+73	+ 7 530	+27
Lower St. Lawrence	− 8 096	−53	−5 226	−49	+ 3 266	+37	−10 056	−29	+ 3 528	+14	− 6 528	−11
Southwestern Ontario	−12 831	−20	+ 311	+23	+22 526	+39	+10 006	+ 8	+32 235	+57	+42 241	+24
Prairies	−34 051	−17	+2 796	+47	+ 7 238	+30	−24 017	−10	+41 899	+30	+17 882	+ 5

Sources: Dominion Bureau of Statistics, *1961 Census of Canada*, Vol. III, Pt. 2, *Labour Force*, Cat. No. 94-519, 94-520, 94-521, and 94-522; Statistics Canada, *1971 Census of Canada*, Vol. III, Pt. 4, *Industries*, Cat. No. 94-741, 94-744, and 94-745.

major changes in the growth trends of farm or rural town components could be drawn from these data. There is some evidence of an earlier general boost in the growth rate of the non-farm and non-town component which was not reflected in the 1966-71 growth rate figure for the total rural population. Perhaps this is because in that period it was masked by a temporarily higher rate of decline of the farm population component, which was then relatively more important than it is now.

CHANGING EMPLOYMENT PROFILES IN FOUR RURAL REGIONS

Consideration of changes in the levels of the three components of rural population led us to conclude that rural population changes in Canada between 1961 and 1976 depended on more than just the rate of decline of the farm population and the percentage of the rural population living on farms. This in turn prompted questions about other non-agricultural bases of economic activity in rural regions, and suggested that we consider changing employment profiles in some of our study regions.

Four of our nine regions were chosen for such more detailed scrutiny – Prince Edward Island, Lower St. Lawrence, Southwestern Ontario, and the Prairies. Thus our subsample included two 'problem regions' whose rural populations declined persistently between 1961 and 1976, and two regions whose rural populations rose significantly during the same period. Refe-

TABLE 6. RURAL LABOR FORCE PARTICIPATION RATES BY REGION, NINE SELECTED CANADIAN REGIONS, 1961, 1971, AND 1976

Region	1961			1971			1976		
	Rural Population 15 Years of Age and Over	Rural Labor Force	Participation Rate	Rural Population 15 Years of Age and Over	Rural Labor Force	Participation Rate	Rural Population 15 Years of Age and Over	Rural Labor Force	Participation Rate
	– no.	–	%	– no.	–	%	– no.	–	%
Prince Edward Island	54 208	27 563	51	62 005	25 390	57	71 290	43 195	61
Western Nova Scotia	161 862	74 604	46	177 090	89 575	51	199 025	104 100	52
Lower St. Lawrence	135 240	60 962	45	132 340	57 180	43	138 235	67 825	49
Southeastern Quebec	215 042	105 562	49	234 290	116 810	50	260 065	142 145	55
Southeastern Ontario	156 923	80 338	51	179 385	103 165	57	209 695	125 350	60
Southwestern Ontario	333 938	181 344	54	372 905	223 645	60	423 145	269 985	64
Winnipeg fringe	80 370	40 622	51	84 480	48 255	57	98 955	62 040	63
Prairies	712 402	374 747	53	681 945	395 550	58	699 415	451 795	65
Calgary-Edmonton corridor	119 991	65 815	55	141 245	85 855	61	196 265	132 340	67

Sources: Dominion Bureau of Statistics, *1961 Census of Canada*, Vol. III, *Labour Force*, Cat. No. 94-533, Statistics Canada, *1971 Census of Canada*, Vol. III, *Labour Force and Individual Income*, Cat. No. 94-708; Statistics Canada, *1976 Census of Canada*, Vol. 5, *Labour Force Activity*, Cat. No. 94-801.

rence has already been made to the facts that our rural employment profiles are based on labor force data, and that the pattern of change in farm employment follows rather closely the pattern of decline in farm numbers and the population living on farms. (See also Table 9.)

Farm Employment as a Percentage of Total Rural Employment

It might be hypothesized that the rate of decline or growth of the rural population depends on the proportion of rural employment contributed by agricultural employment; the higher this proportion then the greater the rate of decline (or the lower the growth rate of the rural population.

This hypothesis is most consistent with the experience in the Prairies where the farm work force constituted the highest proportion of the total rural work force (Table 5) and the rate of rural population decline was exceeded only by that in the Lower St. Lawrence region (Table 2). This latter region, on the other hand, had the highest rate of rural population decline and yet its agricultural percentage of the work force was lowest. Furthermore, the rural population of Southwestern Ontario, with the second highest agricultural percentage in its rural labor force, increased.

Some support for this hypothesis, however, may derive from the consideration of all four regions in a dynamic or 'time series' sense. The farm work force as a proportion of the rural labor force declined in all regions during the 15-year period, and was therefore lowest, in each case, in the last 5 years of this period. The rate of rural population decline was also lowest (or the rate of rural population increase highest) during this last of the three intercensal periods. Other explanations of the latter phenomenon are also conceivable.

Employment in the Non-Agricultural Primary Sector

Another reasonable hypothesis is that the rate of decline of the rural population depends on the rate of job loss in the non-agricultural primary sector (forestry, mining, fishing, and hunting).

Looking at the rate of change in the work force engaged in the non-agricultural primary sector (available for the 1961-71 decade only) revealed dramatic differences between regions (Table 6). The significant increases in the Prairies and Southwestern Ontario can be heavily discounted because 'other primary' constituted such a small proportion of the rural labor force in these two regions anyway (Table 5). However, the 49 percent decline in non-agricultural primary sector jobs in Lower St. Lawrence, in light of the fact that they comprised 18 percent of all jobs for the rural work force in that region in 1961, is significant. It could offer a key as to why the rate of rural population change was so much higher in Lower St. Lawrence than in Prince Edward Island, even though the rates of farm structural change, as indicated by the rates of decline of the three farm variables (numbers, population, and work force) were not too different between these two regions.

The relevance of this hypothesis will vary depending on the importance of non-agricultural primary activities in the region's rural economy.

Employment in the Secondary Sector

Rural employment in the secondary sector (which comprises the manufacturing and construction industries) rose in all four regions between 1961 and 1971 (Table 5). It might be expected that the rate of decline in the rural population will be less (or the rate of increase higher) the higher the rate of job increases in the secondary sector.

The Lower St. Lawrence had a considerably lower rate of increase in the secondary sector work force than Prince Edward Island (Table 5). This appears to provide a further explanation for the high rate of rural population decline in this region, compared with that of Prince Edward Island when the rates of structural change in farming in the two regions were similar.

Employment in the Tertiary Sector

Statistics Canada's industrial classification includes the following industrial subgroups in the tertiary sector:

- transportation, communications, and utilities;
- trade and commerce (retail and wholesale);
- finance, insurance, and real estate;
- public administration and defence; and
- services (community, business, and personal).

Among these, the biggest single source of employment is the last – services – which includes many different activities ranging from churches to body-rub parlors. The most important are educational, accommodation, food, and health services.

Tertiary industries are on the whole 'non-basic', in the sense that the demand they serve is generated by and dependent upon the fortunes of already established 'basic' industries in the same region. In today's specialized commercialized world, basic industries, by contrast, at least partly serve a demand from outside the region. Economic and employment multipliers associated with basic industries are usually, though not necessarily, higher than multipliers of non-basic industries. Some tourist and recreational activities provide exceptions to the general rule that tertiary industries are non-basic. Similarly, some aspects of the construction industry, although included in the secondary sector, are truly

TABLE 7. 1961-71 CHANGE AND ESTIMATED 1971-76 CHANGE IN THE AGRICULTURAL AND NON-AGRICULTURAL LABOR FORCE, FOUR SELECTED CANADIAN REGIONS

Region	Agricultural Labor Force					Non-Agricultural Labor Force				
	1961	1971	1976[a]	Change 1961-71	Change 1971-76[a]	1961	1971	1976[a]	Change 1961-71	Change 1971-76
	—	no.	—	— %	—	—	no.	—	— %	—
Prince Edward Island	9 129	5 795	4 370	−37	−25	18 311	29 175	38 825	+59	+33
Lower St. Lawrence	15 246	7 150	4 479	−53	−36	45 177	46 745	63 346	+ 3	+36
Southwestern Ontario	62 666	49 835	44 019	−20	−11	115 493	170 565	225 966	+48	+32
Prairies	204 836	170 785	155 056	−17	−12	169 092	221 025	296 739	+31	+34

[a]We estimated the level of the agricultural labor force in 1976 by assuming that the ratio of the change in the agricultural labor force to the change in the farm population between 1971 and 1976 was the same as between 1961 and 1971. The size of the non-agricultural labor force in 1976 was then obtained by subtraction from the observed total rural labor force.

Sources: Dominion Bureau of Statistics, *1961 Census of Canada,* Vol. III, Pt. 2, *Labour Force,* Cat. No. 94-519, 94-520, 94-521, and 94-522; Statistics Canada, *1971 Census of Canada,* Vol. III, Pt. 4, *Industries,* Cat. No. 94-741, 94-744, 94-745 and Statistics Canada, *1976 Census of Canada.*

non-basic. Nevertheless, for practical purposes, it may be useful to consider primary and secondary industries as basic and tertiary industries as non-basic. Such thinking suggests the hypothesis that the employment level in the tertiary sector is determined by and follows the employment level in the primary and secondary sector.

In our four regions, tertiary sector employment levels did not appear to be very closely associated with primary and secondary sector employment levels (Table 5). In only one region was the direction of change between 1961 and 1971 consistent. All regions showed an increase in tertiary sector employment during the decade. This suggests that a time-trend towards more service sector employment is probably more important. Such would be consistent with the well-recognized macro-economic phenomenon of a gradual shift from primary and secondary sector employment to tertiary sector employment with economic development. One would expect that this phenomenon, usually illustrated and discussed in the context of a whole country, would apply equally well to regional economic development.

Impact of Urban Industrial Centers within Commuting Distance

It might also be hypothesized that the rural population will increase faster (or decline slower) in those rural regions surrounding or lying close to a greater aggregate of urban industrial centers. The growth rate of urban industrial centers within commuting distance and the general state of the roads (determining the commutable distance) could also be relevant.

Because the labor force data used here were recorded according to a person's place of residence, they include rural residents (as defined in this paper) who worked in population centers of 10 000 or more. Thus alternatives to agricultural employment for rural residents were located not only in rural areas but also in urban centers within commuting distance.

Both labor force growth in the non-primary sector and the substantial increase in the rural non-farm population in Southwestern Ontario suggest that accessibility to urban centers has helped to counteract farm consolidation's negative effect on rural employment and population growth. With the exception of those residents in the northeastern part of the region, rural residents of Southwestern Ontario are less than 60 miles (on generally good roads) from major urban centers like London, Guelph, and Kitchener-Waterloo.

These and some smaller centers benefited from a change in industrial location decisions which began to favor sites which were outside Toronto but still well connected with the city and other major markets. Because of their broader economic base and population growth these centers offered a wider range and larger number of job opportunities than cities located within the boundaries of the other three rural regions. The advantages of accessibility to urban industrial centers which the Southwestern Ontario region has over the Prairies and the Lower St. Lawrence, and the advantages of the collective size of those centers which it has over all the other three regions, is probably a major reason for this region's having the highest rate of rural population increase of the four. In 1971 the total population in urban centers located within the boundaries of the Southwestern Ontario region was about 560 000 – 8 percent more than the rural population at that time. However, in the Prairies the urban center population was only 48 percent of the rural population at that time; in the Lower St. Lawrence it was 27 percent and in Prince Edward Island 29 percent.

TABLE 8. FORECASTS FOR 1986

Region	Agricultural Labor Force			Labor Force of Other Industries			Total Labor Force			Labor Force Participation Rate		Total Working-Age Rural Population		
	1976 Level (Estimated)	Assumed 10-Year Decline	1986 Level (Projected)	1976 Level (Estimated)	Assumed 10-Year Increase	1986 Level (Projected)	1976 Level (Observed)	1986 Level (Projected)	Implicit 10-Year Increase	1976 Observed	1986 (Assumed)	1976 (Observed)	1986 (Projected)	Chance 1976-86 (Projected)
	no.	%	no.	no.	%	no.	no.	no.	%	%	%	no.	no.	%
Prince Edward Island	4 370	−40	2 622	38 825	+50	58 238	43 195	60 860	+41	61	68	71 290	89 500	+26
Lower St. Lawrence	4 479	−60	1 792	63 346	+50	95 019	67 825	96 811	+43	49	57	138 235	169 844	+23
Southwestern Ontario	44 019	−20	35 215	225 966	+50	338 949	269 985	374 164	+39	64	70	423 145	534 520	+26
Prairies	155 056	−20	124 045	296 739	+50	445 109	451 795	569 156	+26	65	72	699 415	790 492	+13

A certain proportion of Canadians prefer to live in a rural area and commute to a job in an urban area. There have been indications that this proportion is rising. Even if the desire is not growing, the number of people doing this can be expected to increase as roads and transportation facilities improve and if housing costs remain lower in rural areas. A connection between the massive spending by the Department of Regional and Economic Expansion (per head of population) on P.E.I. road improvements in the late 1960s and early 1970s and the much higher rural population increase rate in that province during the last intercensal period is likely. Rising gasoline prices could be expected to be a force acting in the opposite direction.

Impact of a Changing Labor Force Participation Rate

It is significant that even though the rural population of the Prairies was falling between 1961 and 1971 (Table 1) the size of its rural labor force was rising (Table 5). The same phenomenon can be observed in the Lower St. Lawrence region in the 1971-76 period (Table 6). Similarly, in Prince Edward Island and Southwestern Ontario the increase rates in the rural labor force were much higher than the corresponding rates of increase in the rural population.

The explanation for these phenomena appears to lie with the increasing labor force participation rate, here defined as the ratio of the labor force to the total population of 15 years and more. Growth in the labor force participation rate has occurred throughout Canada within the last 2 decades. This trend is also apparent to a varying degree in each of our four rural regions (Table 6).

In the Prairies between 1961 and 1976 the agricultural labor force declined approximately 50 000, while the non-agricultural labor force rose about 128 000 – a net gain of 78 000 (Table 7). This represents an increase of more than 20 percent in the labor force, and perhaps about 18 percent in the number of jobs in that region after adjustment for an increase in the unemployment rate in 1976, compared with that in 1961. This would suggest that had the labor force participation rate remained constant during the 15-year period, a population increase of 15-20 percent in the Prairies, rather than the 11 percent decrease which occurred, could have been sustained by the net increase in overall economic activity.

PROJECTIONS TO 1986

To put our findings in perspective for this decade, we have made some broad projections for the agricultural and non-agricultural labor force components in the four rural regions for 1986. We particularly explored the sensitivity of the total rural work force size and the associated rural population level to the assumed rate of farm employment decline (i.e., to the assumed rate of structural change in farming).

Labor force data were not tabulated by industry group for the 1976 census, but changes in the size of the agricultural labor force between 1971 and 1976 have been estimated from changes in the farm population size. Between 1961 and 1971 there was a close relationship between the change in the agricultural labor force and the percent change in farm population for all nine regions (Table 9). Based on the assumption that this relationship continued after 1971, the observed decline in farm population between 1971 and 1976 was used to estimate the rate of decline in the agricultural labor force between 1971 and 1976 (Table 7).

Table 8 summarizes projection assumptions and outcomes. Assumptions about labor force growth in the non-agricultural sectors in the 1976-86 period are generally more conservative than the trends observed for 1961-71 and estimated for 1971-76 (Table 7).

TABLE 9. RATES OF CHANGE IN THE FARM LABOR FORCE, POPULATION LIVING ON FARMS AND CENSUS FARM NUMBERS, NINE SELECTED CANADIAN REGIONS, 1961-71

Region	Change, 1961 - 71		
	Farm Labor Force	Population on Farms	Census Farms
	no.	%	no.
Prince Edward Island	−37	−39	−38
Western Nova Scotia	−38	−51	−51
Lower St. Lawrence	−53	−52	−45
Southeastern Quebec	−48	−42	−38
Southeastern Ontario	n.a.[a]	−30	−25
Southwestern Ontario	−20	−20	−12
Winnipeg fringe	n.a.	−25	−20
Prairies	−17	−22	−18
Calgary-Edmonton corridor	−11	−16	−12

[a]Non-applicable.

Sources: For population on farms see Table 1.
For farm labor force see Table 4.
For census farms see Statistics Canada, *Census of Agriculture,* 1961 and 1971.

Furthermore, the assumed increases in labor force participation rates are much more modest than the increases observed in the past 15 years since increases in this rate cannot continue forever.

While healthy rural population increases in all four regions are projected for the 1976-86 period, even under rather conservative assumptions, the main value of such a simplistic framework is in testing the sensitivity of the outcome to changes in the assumption of the declining agricultural work force. For example, if the rate of decline in the agricultural work force could be halved, what would be the implications for the projected increase in the working age rural population? We found that the projected 10-year rate of increase in the working age rural population would change in Prince Edward Island from 26 percent to 27 percent, in the Lower St. Lawrence from 23 percent to 25 percent, in Southwestern Ontario from 26 percent to 28 percent, and in the Prairies from 13 percent to 16 percent.

The foregoing calculations allow for only a direct impact on total rural employment and population levels of jobs saved in the farming sector if the rate of structural change is reduced. Alternatively, one could make one more assumption and take account of a multiplier effect. For example, if it is assumed that associated with every job in the farm sector is one job in the non-farm sector (employment multiplier = 1.0) then the above impacts are doubled. That is, halving the projected rate of decline of farm jobs will result in improvements in the projected 10-year rural population growth rates from 26 percent to 29 percent in Prince Edward Island, from 23 percent to 26 percent in Lower St. Lawrence, from 26 percent to 29 percent in Southwestern Ontario, and from 13 percent to 19 percent in the Prairies. These impacts are still, nevertheless, rather small.

We can tentatively conclude, therefore, that, even in regions like the Prairies where agriculture still dominates the economy, future changes in rural population on a regional scale will be little affected by the rate of structural change in agriculture.

SUMMARY AND CONCLUSIONS

In all nine Canadian rural regions studied the farm population fell during the 1961-76 period, though not at the same rate in all regions. This trend was offset by a rise in the non-farm component of the rural population in all regions during the same 15-year period.

Little evidence could be found to suggest that long-term trends in farm populations and in rural town populations were changing significantly. There was, however, some evidence for a boost in the growth rate in the non-farm and non-town component of rural population, with the actual timing of this boost varying somewhat among regions. An apparent significant change in the aggregate rate of change in the rural population in the 1971-76 period is largely illusory. The same trends can be expected to continue.

Differences between regions in (a) the rate of change of the farm population (or farm numbers or the farm work force) and (b) the percentage of total rural population (rural work force) accounted for by the farm population (farm work force) provide at best only a partial explanation of the variation between regions in the direction and rate of change of total rural population.

The data examined appear to lend support to theories suggesting that changing employment levels in other basic industries, the general (time) trend towards more employment in the tertiary sector, and the effective proximity and volume of urban economic activity can all also be important determinants of rural population change.

Increases in the labor force participation rates of rural populations would seem to have had serious implications for the overall rates of change of these populations during the period studied. It is inconceivable that the same rates of increase in this participation rate observed between 1961 and 1976 could be repeated, except in parts of eastern Canada where this social change lagged and was really only getting under way in the 1970s. These latter regions aside, this fact alone should lead us to expect generally more rapid growth rates of rural population levels in the future.

Significant rural population increases are projected for 1976-86, even in those regions where the rural population decreased in the previous 15 years. This is largely because the farm population has generally declined as a percentage of total rural population to a point where further farm population decreases will have a much smaller impact on the rural economy than they have had in the past. The Prairies remain the most vulnerable to the effects of further farm population decline. However, even in this region, a 50 percent reduction in the projected future rate of decline of the farm labor force (to 20 percent rather than 40 percent over 10 years) can only be expected to increase the 10-year growth rate in rural population from the projected 13 percent to something like 19 percent.

Continuing decreases in farm numbers and farm population will generate less political concern than they have in the past.

Since this analysis has been conducted at the regional level, the foregoing conclusions are not necessarily applicable to individual rural communities.

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A comparison of rearing broilers at different stocking densities: An economic analysis

Energy Costs, investment costs, and the overall cost of production of chicken and turkey broilers have escalated in the past decade. Agriculture Canada poultry scientists at the Kentville Research Station in Nova Scotia have identified some areas where costs can be reduced by sound managerial practices. A major study area has been the effect of reducing floor space per bird below the suggested or cost of production average floor area of 0.8 ft² per chicken broiler and 2.33 ft² per turkey broiler. This paper augments the experimental results and highlights the general economic benefits associated with input factor management.

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INTRODUCTION

Despite major advances in poultry nutrition, genetics, health, and least-cost feed formulations, there is a continuing need to reduce production costs within the broiler industry. Research in poultry management has generally been devoted to improving product quality and manipulating the variable costs of production. Although these lines of research will continue to be important, a greater reduction in production costs can be expected by minimizing the fixed costs per kilogram of meat. High construction costs and interest rates have particularly elevated the investment costs per unit of production. Producers and researchers should seriously consider managerial practices which would reduce the impact of the "dirti-five" (depreciation, interest, repairs, taxes, and insurance) as a percentage of total production costs.

Some basic research has been conducted on reducing fixed production costs. Hansen *et al.* (1956) and later Proudfoot *et al.* (1979a) and Parkhurst *et al.* (1977) reported that gross returns increase significantly when more turkey broilers per recommended floor area are reared, thus reducing the fixed cost per unit product. These reports demonstrate the potential for saving production costs by rearing chicken or turkey broilers at much higher stocking densities than the accepted norm (e.g., Nova Scotia's density is 0.8 ft^2/chicken broiler). This study elaborates the economic aspects of the studies by Proudfoot and Hulan, undertaken at Agriculture Canada's Kentville Research Station, which evaluate the production performance of rearing chicken and turkey broilers at different stocking densities.

This paper may be useful to farmers intending to increase their yearly production (subject to changes in quota allocation) and who must weigh investment in farm buildings, and other fixed costs, against other managerial alternatives to increase their net farm income. In addition, the paper extends the analysis to consider reduction in production costs which may be

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beneficial to marketing boards, producers, and consumers. Furthermore, it highlights some risks that should be considered for high stocking densities.

Nothing in this paper should be construed as a suggestion to produce over quota allocations. Rather, it is an economic analysis examining the effects of increasing production for a given fixed resource, that is, equipped buildings and other fixed assets.

EXPERIMENTAL METHODS AND RESULTS

Proudfoot, Hulan, and DeWitt (1979) and Proudfoot, Hulan, and Ramey (1979) conducted experiments at the Kentville Research Station to examine the effect of high stocking density and other factors on turkey and chicken broilers. These papers should be read for a more detailed account than what appears in the following summary.

Experiment One

In the first experiment, 3544 chicken broilers were housed at 3.72, 5.55, 7.44, and 9.27 dm^2 (.04, 0.6, 0.8, and 1.0 ft^2) of floor area per bird with 1380, 920, 692, and 552 birds housed per treatment respectively. The sexes were intermingled in equal numbers. Each bird was exposed to an adequate and equivalent waterer and feeder space regardless of the stocking density. Commercial starter (crumbles) and grower and finisher diets (pellets) were fed *ad libitum* to all birds. Heat, light (started at 25 lux and gradually reduced to 5 lux by 21 days of age), and all other production inputs were adequately supplied. The experiment was terminated when the birds reached 51 days of age.

Appendix A shows the production performance and summarizes the experiment. One can see that with increasing stocking density occurs a nearly linear reduction in individual bird body weight. Similarly, the incidence of breast blisters (affecting carcass quality) increases significantly. However, while the product's quality decreases, increasing stocking density produces a significant increase in total live body weights and returns per unit of floor area.

Experiment Two

The experiment on turkey broilers consisted of two parts.

Part One

A total of 2028 turkey poults (Hybrid Diamond White Strain) were housed in 18 pens, each with a floor area of 1354 dm^2 (146 ft^2). Three sex populations were considered. Male poults were housed at 11.10, 14.72, and 18.81 dm^2 (1.20, 1.59, and 2.03 ft^2) of floor space per bird respectively. Females were housed at 7.44, 11.10, and 14.7 dm^2 (0.80, 1.20, and 1.58 ft^2) per bird. The third population consisted of equal numbers of both sexes and were housed at 9.27, 13.02, and 16.51 dm^2 (1.00, 1.40, and 1.78 ft^2) of floor space per bird. Each stocking density-sex combination was duplicated. All birds received the same lighting regimen, 23L:1D (23 hours of daylight and one hour of darkness) per day. The number of feeders and waterers was increased as stocking density increased. The experimental population was marketed at 98 days of age.

Part Two

The sexes were intermingled with 5400 poults housed in 36 pens, each with a floor area of 1354 dm^2. The day-old poults were randomly assigned to six pens within each of six light-controlled zones in the test building. Each light zone contained two pens of each stocking density, that is, 7.44, 9.27, and 11.10 dm^2 of floor space per bird, respectively. Birds in one pen of each stocking density, within each light zone, were toe clipped (removing claws from digits 1, 2, and 3). The three light treatments were duplicated and consisted of (1) low intensity white (.4 lux), (2) medium intensity white (7 lux), and (3) low intensity green (.4 lux). Incandescent bulbs supplied the light. The experiment was terminated when the birds were 98 days of age.

In both experiments, mortality was almost constant in each treatment. There was a significant effect of treatment on body weights with higher stocking densities, resulting in a significant reduction in body weights. However, despite the detrimental effect of high stocking densities on body weights, monetary returns per unit of floor area increased significantly as stocking densities were raised.

ECONOMIC METHODS AND EVALUATION PROCEDURES

A partial budgetary technique was adopted to estimate the profitability of increasing stocking density in a commercial operation. The average size of a commercial chicken farm unit in Nova Scotia was assumed to be 30 000 broilers per crop, while that of turkey broilers (light turkeys) was estimated at 10 000 broilers per crop. Knowing that the marketing boards assign 7.44 dm^2 (0.8 ft^2) per chicken broiler and 21.67 dm^2 (2.33 ft^2) per turkey broiler in their cost of production model, it follows that the recommended floor space of buildings is 2164 m^2 (24 000 ft^2) for chicken broilers and 2100 m^2 (23 000 ft^2) for turkey broulers. Production data from the research of Proudfoot *et al.* (1979a and 1979b) (see Appendix A for chicken broilers and Appendix B for turkey broilers) provided the basis for estimating feed consumed, meat produced, mortality, and carcass quality. Investment costs on buildings and equipment were based on estimates for 1979 supplied by the

Engineering Division of the N.S. Department of Agriculture and Marketing, Truro, Nova Scotia.* Actual building costs from producers in 1979 verified the reliability of the estimates. Feed prices were obtained from Co-Op Atlantic, New Minas, Nova Scotia, and chick prices from Canard Poultry, Division of Canada Packers, Canard, Nova Scotia, and represent average costs for 1979. Operating costs such as labor, litter, energy, and other miscellaneous costs were not estimated. Rather, costs that are believed to be approximately constant to all producers at any given time and geographic location were the key elements considered in establishing the effect of different stocking densities on returns to poultry producers. Addition of operating costs to the model would provide the producer a net income figure for his operation.

The following were identified as the major factors making up most of the cost of producing poultry meat (Tables 1 and 2):

- In the absence of discounts, producers expect to pay the same price for bulk-delivered medicated feed.
- In the experimental data (Appendices A and B) no significant difference exists in the feed conversion ratio (FCR) between the various treatments. The FCR was calculated at 2.1225 for chicken broilers and 2.5211 for turkey broilers. Total feed cost is the sum of the amounts of different kinds of feed – starter, grower, and finisher consumed at the various stages of growth. Feed cost is the product of meat produced, the FCR, and the feed price. It was assumed that all producers pay the same price for chicks and poults.
- To calculate investment and fixed overhead costs, 1979 was taken as the base year. The factors considered to be constant to all producers, assuming a constant total investment cost per square foot of \$6.25 are depreciation costs of 5% a year for buildings and 10% a year for equipment, and municipal taxes at \$.48 for \$100 of property assessment (rate set by Municipality of Kings County, Nova Scotia, 1979) on buildings. Only interest on investment was calculated and that at a 7% a year rate from the N.S. Farm Loan Board. (Similar farm loan bodies operate in some other parts of the country.) The rate applies to the total cost of buildings and equipment; current cost for insurance on buildings and equipment is \$12.00 for 3 years for \$1000 worth of property.
- Costs for administrative services and costs for buildings, equipment, and yard maintenance were estimated to be equal on all farms of the same size.

*Personal communication.

The price per kilogram of live weight is the aggregate 1979 average compiled by the N.S. Chicken Marketing Board and the N.S. Turkey Marketing Board. The price is \$.92/kg for chicken broilers and \$1.19/kg for turkey broilers.

The following adjustments to the experimental data were made to derive total returns from broiler sales:

- The rate of mortality is constant over the observed densities. The experimental data show no significant difference in mortality due to stocking density for the chicken and turkey broilers.
- Because of an inconsistent relationship between mean live weight per bird in the experimental results (Appendix B), live body weights of male turkeys in the intermingled sexes were scaled proportionately to body weights across stocking densities in the all-male group.

Gross returns, defined as the value of poultry meat produced, are calculated from the product of total live body weights produced and the price per unit weight. Returns after poult, feed, and fixed overhead costs are an estimate of the returns to the farm operator before computing returns to labor, overhead, and equity.

ANALYSIS

Two basic cases were considered in this study. First, since stocking density is the principal variable that determines the floor area required to produce a given quota, we considered the investment costs for three different densities and their corresponding floor areas. This case is typical for a new producer considering appropriate building size, but it also provides a benchmark for estimating returns to capital investment as calculated on present market value. The second case assumes existing buildings and considers the returns of increased production through increased stocking density. This case uses the excess capacity in present structures to increase production and avoids additional capital expenditure.

When a farmer is allocated a quota to produce a specified amount of poultry meat and he can choose the stocking density (floor space per bird) and the corresponding size of building to be constructed, variations are found between the number of birds reared, initial investment on buildings and equipment, annual fixed costs, and total returns per crop. Investment costs on buildings and equipment to produce the same amount of meat range from a high of about \$150 000 at 1.0 ft^2 (9.27 dm^2) per bird to a low of about \$70 000 in a density of 0.4 ft^2 (3.71 dm^2) per bird in chicken broiler housing (Table 1) and a range of about \$100 000 to \$60 000 in turkey broilers (Table 2). In addition, total chick, feed, and fixed costs per kilogram of broiler

TABLE 1. EFFECT OF BUILDING SIZE FOR DIFFERENT STOCKING DENSITIES ON RETURNS OVER CHICK, FEED, AND ANNUAL INVESTMENT (FIXED) COSTS FOR CHICKEN BROILERS, 1979, FOR A GIVEN QUOTA OF 50 455 KG PER CROP

Allocated quota: 50 455 kg per crop @ 4.5 crops per year

Investment:[a]

Buildings . . . . $5.00/ft^2

Equipment . . . . $1.25/ft^2

	Floor Space Per Bird			
	9.27 dm^2 (1.0 ft^2)	7.44 dm^2 (0.8 ft^2)	5.55dm^2 (0.6ft^2)	3.72 dm^2 (0.4 ft^2)
Quota allocation (kg)	50 455	50 455	50 455	50 455
Birds finished (no.)	24 363	25 009	25 393	27 466
Birds started (no.)	25 778	26 461	26 867	29 060
Floor area required (ft^2)	24 363	20 007	15 236	10 986
Investment on buildings	121 815	100 035	76 180	54 930
Investment on equipment	30 454	25 009	19 045	13 733
Total investment per farm unit	152 269	125 044	95 225	68 663
Chick cost @ 27¢ per chick	6 960	7 145	7 254	7 846
Feed cost	29 717	29 717	29 717	29 717
Chick and feed costs	36 677	36 862	36 971	37 563
Fixed (Overhead) Costs				
Depreciation: Buildings	6 091	5 002	3 809	2 747
Equipment	3 045	2 501	1 905	1 373
Buildings, equipment, and yard maintenance	2 600	2 600	2 600	2 600
Insurance – $12/$1000/3 yr.	609	500	381	275
Taxes – $0.48/$100 on buildings	585	480	366	264
Interest on indebtedness (7%)	10 659	8 753	6 666	4 806
Administration	350	350	350	350
Total fixed costs per year	23 939	20 186	16 077	12 415
Total fixed costs per crop	5 320	4 486	3 573	2 759
Total chick, feed, and fixed costs per crop	41 997	41 348	40 544	40 322
Gross returns @ 92.16¢ /kg	48 518	48 518	48 518	48 518
Gross returns	46 191	46 137	46 126	45 925
Returns (graded) after chick, feed, and fixed costs per crop	4 194	4 789	5 582	5 603
Returns after chick, feed, and fixed costs per crop	6 521	7 170	7 974	8 196

[a]Source: N.S. Department of Agriculture & Marketing (Engineering Division), Truro, Nova Scotia.

meat decline from a high of 83.24 cents to a low of 79.92 cents in chicken broilers and range between 99.16 cents to 90.84 cents in turkey broilers. Tables 1 and 2 depict the relationships between different stocking densities and production costs when an allocated quota is assigned to a producer. The returns demonstrate the measure and degree of profitability when different sizes of broiler houses are considered. The buildings are constructed with just enough floor area to produce the required quota allocated. Therefore, the farmer with limited capital could maximize his profits by investing in only the floor footage required for his purpose.

Tables 3 and 4 show a trend similar to that in Tables 1 and 2. The net effect of increasing stocking densities in turkey and chicken broilers on a fixed floor area is a significant reduction in the cost of production of about $.01/kg. A $.01 increase in returns will represent an additional income of about $2000 a year. Tables 3 and 4 show the relationships among stocking densities and the production costs of chicken and turkey broilers. The tables demonstrate the effect of increasing bird stocking densities on a fixed floor area. Floor space is considered as an independent variable and its allocation per bird is flexible. On a given floor area, increasing bird density

TABLE 2. EFFECT OF BUILDING SIZE AND STOCKING DENSITY ON RETURNS OVER POULT, FEED, AND ANNUAL INVESTMENT (FIXED) COST OF TURKEY BROILERS IN 1979 FOR A FIXED QUOTA OF 47 728 KG/PER CROP

Unit Investment[a]: Production capacity: three crops per year

Buildings . . . . $5.00/$ft^2$
Equipment . . . . $1.25/$ft^2$

	Males			Females			Intermingled Sexes		
Floor space per bird	11.10 dm^2 (1.19 ft^2)	14.72 dm^2 (1.58 ft^2)	18.81 dm^2 (2.02 ft^2)	7.44 dm^2 (0.8 ft^2)	11.10 dm^2 (1.10 ft^2)	14.72 dm^2 (1.58 ft^2)	9.27 dm^2 (1.00 ft^2)	13.02 dm^2 (1.40 ft^2)	16. 51 dm^2 (1.72 ft^2)
Quota: live wt (kg)	47 728	47 728	47 728	47 728	47 728	47 728	47 728	47 728	47 728
birds per crop (no.)	8 472	8 101	7 934	11 641	10 642	10 642	9 601	9 280	8 895
birds started per crop (no.)	8 714	8 333	8 161	11 974	10 946	10 946	9 876	9 545	9 149
Floor area required (ft^2)	10 082	12 800	16 027	9 313	10 326	17 295	9 601	12 992	15 299
Investment on buildings ($)	50 410	64 000	80 135	46 565	65 130	86 475	$48 005	$64 960	$76 495
Investment on equipment ($)	12 603	16 000	20 034	11 641	16 283	21 619	$12 001	$16 240	$19 124
Total investment on buildings and equipment ($)	63 013	80 000	100 169	58 206	81 413	108 094	$60 006	$81 200	$ 95 619
					$				
Feed cost	32 156	32 156	32 156	32 156	32 156	32 156	32 156	32 156	32 156
Poult cost	7 407	7 083	6 937	10 178	9 304	9 304	8 395	8 113	7 777
Feed and poult costs	39 563	39 239	39 093	42 334	41 460	41 460	40 551	40 269	39 933
Fixed (overhead) costs					$				
Depreciation: Buildings (5%)	2 521	3 200	4 007	2 328	3 257	4 324	2 400	3 248	3 825
Equipment (10%)	1 260	1 600	2 003	1 164	1 628	2 162	1 200	1 624	1 912
Building, equipment, yard maintenance	2 400	2 400	2 400	2 400	2 400	2 400	2 400	2 400	2 400
Taxes 48¢/$100 of buildings	242	307	385	224	313	415	230	312	367
Insurance $12/$1000/3 yr.	252	320	401	233	326	432	240	325	383
Interest on investment (7%)	4 411	5 600	7 012	4 074	5 699	7 567	4 200	5 684	6 693
Administration	300	300	300	300	300	300	300	300	300
Total fixed costs per year	11 386	13 727	16 508	10 723	13 923	17 600	10 970	13 893	15 880
Total fixed costs per crop	3 795	4 576	5 503	3 574	4 641	5 867	3 657	4 631	5 293
Total poult, feed, and fixed costs per crop	43 358	43 815	44 596	45 908	46 101	47 327	44 208	44 900	45 226
Gross returns @ $1.19/kg	56 796	56 796	56 796	56 797	56 796	56 796	56 796	56 796	56 796
Total poult, feed, and fixed costs per kg	0.9084	0.9180	0.9619	0.9619	0.9659	0.9916	0.9262	0.9407	0.9476
Gross returns: Grade A @ $1.19/kg Undergraded @ $1.17¢/kg	Not Estimated	Not Estimated	Not Estimated	56 392	56 482	56 533	56 413	56 412	56 406
Returns (graded) after poult, feed & fixed costs per crop		—		10 484	10 381	9 206	12 205	11 512	11 180
Returns after poult, feed, and fixed costs per crop	13 438	12 981	12 200	10 888	10 695	9 469	12 588	11 896	11 570

[a]Source: N.S. Department of Agriculture & Marketing (Engineering Division), Truro, Nova Scotia.

TABLE 3. EFFECT OF INCREASING STOCKING DENSITIES ON FARM INCOME FOR CHICKEN BROILERS IN 1979 FOR A FIXED FLOOR AREA OF 2 164 m^2 (24 000 ft^2)

Unit: Broiler Building Floor Area – 24 000 ft^2 x 4.5 crops per year

Investment:[a] Buildings . . . . . $5.00 ft^2
Equipment . . . . . $1.25 ft^2

	Floor space per bird			
	9.27 dm^2 (1.0 ft^2)	7.44 dm^2 (0.8 ft^2)	5.55 dm^2 (0.6 ft^2)	3.72 dm^2 (0.4 ft^2)
Given floor area (dm^2)	24 000	24 000	24 000	24 000
Birds finished (no.)	24 000	30 000	40 000	60 000
Birds started (no.)	25 393	31 741	42 321	63 482
Live weight produced (kg)	49 704	60 525	79 480	110 220
		$		
Investment on: Buildings	120 000	–	–	–
Equipment	30 000	–	–	–
Total investment	150 000	150 000	150 000	150 000
Chick cost @ 27¢ per chick	6 856	8 570	11 427	17 140
Feed cost	29 275	35 648	46 814	64 919
Fixed (Overhead) Costs				
Depreciation: Buildings (5%)	6 000	6 000	6 000	6 000
Equipment (10%)	3 000	3 000	3 000	3 000
Buildings, equipment, and yard maintenance	2 600	2 600	2 600	2 600
Insurance – $12/$1000/3 yr.	600	600	600	600
Taxes – $0.48/$100 on buildings	576	576	576	576
Interest on investment	10 500	10 500	10 500	10 500
Administration	350	350	350	350
Total fixed costs per year	23 626	23 626	23 626	23 626
Total fixed costs per crop	5 250	5 250	5 250	5 250
Total chick, feed, and fixed costs per crop	41 381	49 468	63 491	87 309
Total chick, feed, and fixed costs/kg	0.8325	0.8173	0.7988	0.7921
Gross returns @ $0.9216/kg	45 807	55 780	73 249	101 579
Gross returns: Graded A @ $0.9216/kg Undergraded @ $0.9016/kg	45 504	55 346	72 660	100 325
Returns (graded) after chick, feed, and fixed costs per crop	4 123	5 878	9 169	13 016
Returns after chick, feed, and fixed costs per crop	4 426	6 312	9 758	14 270

[a]Source: N.S. Department of Agriculture and Marketing (Engineering Division), Truro, Nova Scotia.

is accompanied by a similar increase in inputs and a very noticeable increase in the total meat produced (returns), and for the range of the experimental data, shows no clear point of diminishing returns. The data also depict the relationship between stocking densities and the differences in gross returns on the one hand, and the relationship between stocking densities and production costs on the other. Increasing bird density reduces the impact of construction and fixed costs, the cost of production per live weight, and simultaneously increases gross farm income (relative to the facility) due to the larger volume of meat produced. Despite the use of larger volume units of input, revenue exceeds costs and net farm income increases. A $.01/kg increase in returns will represent an additional income of about $500 for a farmer who markets about 50 000 kg of chicken and about $470 for a turkey farmer selling about 47 000 kg of turkey.

When a price differential on less than Grade A carcass is assumed to be $.02 less than Grade A carcass in both the chicken and turkey broilers (because of breast blisters at higher stocking densities), returns are still more favorable at lower floor space per bird than the marketing board recommendations of 0.8 ft^2 (7.44 dm^2) per chicken broiler and the 2.33 ft^2 (21.60 dm^2) per turkey broiler as in the cost of production formula.

TABLE 4. EFFECT OF STOCKING DENSITY ON RETURNS OVER POULT, FEED, AND ANNUAL INVESTMENT (FIXED) COSTS FOR TURKEY BROILERS FOR A FIXED FLOOR AREA OF 1 822 m² (20 200 ft²)

Unit Investment:[a] Production capacity three crops per year

Buildings	$101 000	$5.00/ft²
Equipment	$ 25 250	$1.25/ft²

	Males			Females			Intermingled Sexes		
Floor space per bird	11.10 dm² (1.19 ft²)	14.72 dm² (1.58 ft²)	18.81 dm² (2.02 ft²)	7.44 dm² (0.8 ft²)	11.10 dm² (1.19 ft²)	14.72 dm² (1.58 ft²)	19.27 dm² (1.00 ft²)	13.02 dm² (1.40 ft²)	16.51 dm² (1.72 ft²)
Floor space available (dm²)	20 200	20 200	20 200	20 200	20 200	20 200	20 200	20 200	20 200
Capacity of buildings (birds)									
started (no.)	16 975	12 785	10 000	25 250	16 975	12 785	20 200	14 429	11 744
finished (no.)	16 503	12 430	9 722	24 548	16 503	12 430	19 638	14 028	11 418
Live weight produced (kg)	92 978	73 235	58 488	100 647	74 214	55 585	97 621	72 146	61 269
Investments: Buildings	101 000	–	–	–	–	–	–	–	–
Equipment	25 250	–	–	–	–	–	–	–	–
Total investment on buildings & equipment	126 250	126 250	126 250	126 250	126 250	126 250	126 250	126 250	126 250
Poult cost per crop	14 429	10 867	8 500	21 463	14 429	10 867	17 170	12 265	9 982
Feed cost per crop	62 644	49 342	39 406	67 810	50 001	37 450	66 806	46 822	42 124
Total poult and feed cost	77 073	60 209	47 906	89 273	64 430	48 317	83 976	59 087	52 106
Fixed (Overhead) Costs:									
Depreciation – Buildings 5%	5 050	–	–	–	–	–	–	–	–
Equipment 10%	2 525	–	–	–	–	–	–	–	–
Building, Equipment, and Yard Maintenance	2 400	–	–	–	–	–	–	–	–
Insurance	505	–	–	–	–	–	–	–	–
Taxes	485	–	–	–	–	–	–	–	–
Interest on investment (7%)	8 838	–	–	–	–	–	–	–	–
Administration	300	–	–	–	–	–	–	–	–
Total fixed costs per year	20 103	20 103	20 103	20 103	20 103	20 103	20 103	20 103	20 103
Total fixed costs per crop	6 701	6 701	6 701	6 701	6 701	6 701	6 701	6 701	6 701
Total poult, feed, and fixed costs per crop	83 774	66 910	54 607	95 974	71 131	55 018	90 677	65 788	58 807
Total poult, feed, and fixed costs per kg	0.9010	0.9136	0.9336	0.9536	0.9585	0.9898	0.9289	0.9119	0.9598
Gross returns	110 644	87 150	69 601	119 770	88 315	66 146	116 169	85 854	72 910
Gross returns graded A @ $1.19/kg	Not	Not	Not						
undergraded @ $1.17/kg	Estimated	Estimated	Estimated	118 919	87 825	65 839	115 385	85 273	72 409
Returns (graded) after poult, feed and fixed costs per crop	–	–	–	22 945	16 694	10 821	24 708	19 485	11 302
Returns after chick, feed, and fixed costs per crop	26 870	20 240	14 994	23 796	17 184	11 128	25 492	20 066	14 103

[a]Source: N.S. Department of Agriculture & Marketing (Engineering Division), Truro, Nova Scotia.

DISCUSSION

The foregoing analysis demonstrates the potential benefits associated with the practice of high stocking density as a managerial tool to improve the profitability of broiler operations. It is critical to remember that low light intensities were used to control feather picking and cannibalism in both chicken and turkey broiler populations, and that the experiments were conducted during the cooler months of the year. While the experimental performance may not be duplicated exactly in commercial flocks, the results indicate that commercial growers should consider higher densities. However, various uncertainties and risks should be considered.

The broiler producer is confronted with making decisions regarding production timing, bird strain, and the degree of operating competence to maintain performance for the larger volume of birds. High stocking densities will be more profitable only under favorable weather conditions, with the cooler temperatures during fall to spring being preferred. Comfortable temperatures and proper ventilation is a necessity in broiler housing, especially when high stocking density is considered. In the summer, the practice would be difficult to implement because of the higher temperatures and high water vapor loads. Since broilers generate tremendous amounts of heat, moisture, and feces, they require adequate ventilation to eliminate suffocation. The extra costs required to control heat and moisture dissipation at higher stocking densities would have to be assessed before the summer months could be considered. The cost of higher levels of insulation and ventilation per unit live weight would be negligible for new construction.

Other factors that may influence the profitability of high stocking densities are the risks of epidemics or flock losses. No attempt has been made in this paper to estimate their frequency, but sound management and sufficient precautions can prevent such occurrences.

The benefits associated with high stocking densities exceed the measurable costs. Investment costs on buildings and equipment may be cut by half if the size of new buildings and equipment can be constructed to match quota allocations. Heavier densities are more feasible if good insulation and ventilation are included during construction.

Alternatively, a producer can increase production without extending existing facilities. This would enable the producer to supply his quota allocation within shorter periods, thus freeing up time to diversify and simultaneously reduce his annual production costs. Floor space per bird and the number of crops a year could be varied to enhance profitability.

SUMMARY AND CONCLUSIONS

Traditional stocking densities for broilers should be reconsidered when an increase in broiler production is required. The experimental results and estimated budgets show that production practices different from those in the benchmark farm (boards, floor footage recommendation) can increase returns.

The budgets demonstrate that increasing stocking density by reducing the floor area by 0.2 ft^2 per bird from the benchmark densities for broilers would result in at least a \$.01/kg increase in returns of live meat produced and large savings in construction costs when output matches floor space requirements. For the poultry industry that means several million kilograms of additional meat per year. This production technique is worthy of serious consideration.

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APPENDIX A

THE EFFECTS OF FOUR STOCKING DENSITIES ON MORTALITY, BODY WEIGHT, FEED CONVERSION, CARCASS GRADE, INCIDENCE OF BREAST BLISTERS, AND MONETARY RETURN[a] FOR CHICK BROILERS IN EXPERIMENT ONE

Stocking Density	Mortality		Body Weight		Feed Conversion	Grade A Carcasses		Breast Blisters		Mean Monetary Returns Over Feed and Chick Costs	
	Male	Female	Male	Female		Male	Female	Male	Female	Per Bird Started	Per dm^2 Floor Space
dm^2/bird	– % –		– g –		–	– % –				– ¢ –	
9.27	8.3	3.3	2275	1867	2.13	58.4	80.5	18.0	5.0	37.8	4.07
7.44	3.8	1.8	2209	1826	2.09	52.1	76.1	25.6	4.7	39.6	5.34
5.55	9.4	4.2	2146	1828	2.12	51.8	74.2	25.7	10.8	35.0	6.28
3.72	8.0	4.8	2016	1658	2.15	27.6	58.6	40.0	16.3	28.7	7.72
SEM[b]	=1.66	=2.15	=29	=19	=.02	=1.13	=2.03	=4.04	=2.72	=.81	=.20
Sign. (5L)[c]	NS	NS	L	L, Q	NS	L, Q, C	L	NS	L	L, Q	L

[a]All percentage data were converted to angles for the statiscal analysis.

[b]SEM is the standard error of the means.

[c]Sign. is significant linear L, quadratic – Q, or cubic – C effects over different stocking densities and NS means not significant at the 5% level of significance.

Source: Proudfoot *et al. Poultry Science* 58: (1979a) 791-793.

APPENDIX B

THE EFFECT OF HOUSING METHOD AND STOCKING DENSITY OF TURKEY BROILERS ON MORTALITY, BODY WEIGHT, FEED CONVERSION, GRADE A CARCASSES, AND MONETARY RETURN IN EXPERIMENT TWO

Housing Method	Stocking Density Per Poult	Mortality[a]		98-Day Live Body Weight		Feed Conversion	Grade A Carcasses		Monetary Returns Over Feed and Poult Cost	
		Male	Female	Male	Female		Male	Female	Per Poult Started	Per m^2
	d^2	— %	—	— g	—	—	— %	—	— $	—
Males only	11.10	2.0	—	5634	—	2.44	—	—	1.68	15.16
	14.72	3.2	—	5892	—	2.38	—	—	1.85	12.55
	18.81	4.8	—	6016	—	2.40	—	—	1.82	9.66
Females only	7.44	—	1.9	—	4100	2.58	—	57.7	0.86	11.54
	11.10	—	2.0	—	4497	2.71	—	67.0	0.90	8.10
	14.72	—	4.4	—	4472	2.60	—	72.4	0.95	6.44
Intermingled sexes	9.27	4.8	0.0	5818	4279	2.51	56.2	63.5	1.30	14.05
	13.02	2.8	1.0	5542	4365	2.57	55.2	64.3	1.18	9.08
	16.51	3.6	1.2	6264	4688	2.50	49.3	68.9	1.53	9.25

[a]Mortality based on birds dying between 14 and 98 days of age.

Source: Proudfoot *et al. Poultry Science* 58 (1979b): 791-793.

Economic Indicators

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1979 I	1979 II	1979 III	1979 IV	1979 Annual	1980 I	1980 II	1980 III	1980 IV	1980 Annual
Production and Income											
1. GNP at market prices[a]	$ mil.	247 496	256 256	264 712	272 756	260 305	278 700[b]	283 102[b]	289 000[b]	301 832	288 136
2. Farm cash receipts, total[d]	$ mil.	3 397.2	2 203.4	3 458.2	3 917.3	14 077.3	3 798.8[b]	3 460.0[b]	3 948.6	4 430.2	15 637.6
3. – total crops[d]	$ mil.	1 454.7	1 212.6	1 480.8	1 774.9	5 923.0	1 339[b]	1 360.6[b]	1 738.7[b]	1 966.6	6 899.7
4. – total livestock[d]	$ mil.	1 863.9	1 951.2	1 881.6	2 051.2	7 747.9	1 900.7[b]	1 974.6[b]	2 118.1	2 324.3	8 317.7
5. Net income rec'd by farm operators[a]	$ mil.	3 988.0	4 348.0	3 280.0	4 152.0	3 942.0	3 708.0	3 404.0	3 736.0	4 072.0	3 730.0
Trade											
6. Agricultural exports	$ mil.	1 204.4	1 354.7	1 663.9	1 884.8	6 107.8	1 501.5	2 008.2	2 003.5	2 331.4	7 844.6
7. Agricultural imports	$ mil.	1 292.2	1 181.6	1 129.4	1 240.4	4 680.6	1 158.9	1 256.9	1 173.6	1 517.8	5 107.2
8. Real domestic product, ag[a]	1971 = 100	109.7	104.9	105.5	112.4	108.1	110.4[b]	109.6[b]	107.7[b]	109.4	109.3
9. Real dom. prod., less ag[a]	1971 = 100	183.3	138.9	140.8	140.4	139.7[b]	139.5[b]	138.7[b]	139.5[b]	141.6	139.9
Price indexes											
10. Farm input price index	1971 = 100	229.5[b]	234.4[b]	236.1[b]	239.6[b]	234.9[b]	253.2[b]	250.3[b]	258.6[b]	267.5	257.4
11. – buildings and fencing	1971 = 100	216.1	233.2	229.5	235.3	226.0	235.5	236.4	242.2	242.7	239.2
12. – machinery & motor veh.	1971 = 100	188.0	191.8	196.2	205.3	193.3	214.2	221.7	227.0[b]	237.4	225.1
13. – crop production	1971 = 100	238.6	252.5	258.5	266.5	254.0	296.9	309.1	304.9[b]	310.7	305.4
14. – animal production	1971 = 100	246.8	252.3	249.2	247.8	249.0	252.7	232.8	256.2[b]	266.8	252.1
15. – hired farm labor	1971 = 100	228.0	232.8	235.7	237.8	233.6	242.1	245.1	249.2	253.1	247.4
16. – interest	1971 = 100	395.3[b]	395.3[b]	395.3[b]	395.3[b]	395.3[b]	466.7	460.9[b]	448.7[b]	473.1	247.4
17. Farm prices of ag. prod.[d]	1971 = 100	250.3[f]	250.7[f]	247.7[f]	246.4[f]	262.1[fb]	262.1[fb]	255.9[fb]	272.3[fb]	290.7[f]	270.2[f]
Input and credit											
18. Farm machinery sales[e]	$ mil.	N.A.	N.A.	N.A.	N.A.	1 701.0	N.A.	N.A.	N.A.	N.A.	1 745.0
19. Employment in agriculture[a]	'000	489.0	489.3	475.7	481.0	483.8	490.0	478.0	466.0	478.0	478.0
20. Av. farm labor rates	$/h	3.89	3.95	4.01	4.08	3.98	4.15	4.22	4.24	4.31	4.23
21. Av. hourly earnings-manuf.	$/h	7.19	7.37	7.50	7.68	7.44	7.89[b]	8.04[b]	8.28[b]	8.53	8.19
22. F.C.C. – gross loan disburs.	$ mil.	35.4	174.7	192.4	145.2	547.7	98.5	189.6	139.3	95.8	427.4
23. CPI – all items	1971 = 100	184.6	189.4	193.1	197.6	191.2	202.0	207.6	213.5	219.5	210.6
24. – food at home	1971 = 100	228.6[b]	237.9	241.6	243.8	238.0	250.3	258.2	270.3	279.4	264.5
25. – food away from home	1971 = 100	213.1	220.8	227.3	232.4	223.4	237.1	240.7	246.6	251.8	244.1
26. Industry selling price index – food & beverage	1971 = 100	225.9	230.1	233.3	237.5	231.7	244.2	247.9	264.8[b]	278.2	258.8

continue

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1979					1980				
		I	II	III	IV	Annual	I	II	III	IV	Annual
Other indicators											
27. Unemployment rate	%	7.9	7.6	7.1	7.3	7.5	7.5	7.7[b]	7.5	7.4	7.5
28. Exchange rate	$ U.S.	1.19	1.16	1.17	1.19	1.17	1.16	1.17	1.16	1.18	1.17
29. Ave. rate on new demand loans	%	12.31	12.55	12.81	15.27	13.24	15.33[b]	16.30	12.61	14.11	14.59
30. Quarterly pop. est.	mil.	23.60	23.64[b]	23.70[b]	23.75[b]	23.67	23.81	23.87	23.94	24.01	23.91

[a]Seasonally adjusted at annual rates.

[b]Revised.

[c]Preliminary.

[d]Excludes Newfoundland.

[e]Includes new machines and repair parts.

[f]Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, *Marketing and Economics Branch;* Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; the *Bank of Canada Review;* and the Canadian Farm and Industrial Equipment Institute.

Notes

AGRICULTURE AND FOOD TRADE SURPLUS SOARS

Agricultural exports rose sharply in 1980 to a record $7.8 billion, up from $6.1 billion the previous year.

Agricultural imports during the same period rose only moderately, from $4.7 billion in 1979 to $5.1 billion in 1980.

This gave Canada an agricultural trade surplus for 1980 of $2.7 billion, up about 90 percent from the 1979 surplus of $1.4 billion.

When food exports, including fish and alcoholic beverages, are added, total agriculture and food exports for 1980 amounted to $9.5 billion. Food imports were valued at $5.8 billion, resulting in a surplus in agriculture and food trade of $3.7 billion. That represents more than two-thirds of Canada's total 1980 trade surplus.

Agriculture and food exports last year accounted for 12.9 percent of total Canadian exports of $73.8 billion. Agriculture and food imports represented 8.4 percent of total Canadian imports in 1980.

ENERGY SAVINGS IN THE MILKING PARLOR

Dairy farmers can save on energy costs by using waste heat from milk to warm water used in washing and sanitizing equipment.

Milk has to be cooled from 38°C to 2°C for safe storage until it is shipped to the processor. The heat given off in the cooling process is currently wasted but could easily be used to heat the water needed to wash and sanitize the milking equipment.

The refrigeration unit used to keep the milk cool is similar to the home refrigerator. A coil within the tank absorbs the heat which is then transferred through the compressor to a second coil outside the tank where it is given off into the air. However, this second coil can be submerged in the hot water tank to transfer the heat to the water.

There are units with this feature now available on the market. They are specifically designed for certain milk flow rates and hot water demands. Researchers are evaluating these units on farms in Quebec.

Studies carried out at Agriculture Canada's Engineering and Statistical Research Institute have shown that milk from a herd of 100 dairy cows produces enough heat when it is cooled to warm all the hot water required in the milking parlor.

This will vary, however, depending on daily milk production rates and the quantity of hot water used by the individual farmer.

The researchers are very optimistic about these energy-saving units. According to their calculations, in the first year alone the savings in electricity for a large operation can pay back the cost of installing such a unit. For smaller herds, this pay-back period is longer.

FARMBANK

FARMBANK is a computerized commodity data base maintained by Agriculture Canada's Marketing and Economics Branch. It contains approximately 1000 regional, national, and international food and agriculture data series for prices, production, stocks, consumption, imports, exports for all major grains and livestock products, as well as farm income statistics, retail prices, and general economic data.

FARMBANK data are mainly quarterly, and originate as far back as 1950. They are collected from Agriculture Canada and other Canadian, U.S., and international sources.

FARMBANK is now available on-line for a monthly fee from the Conference Board of Canada and Datacrown Inc. Prospective clients may contact their marketing representatives for more information about the data base and how to access this information.

Publications

Energy for Agriculture and Food. Publication No. 5142E, 14 pp. *Available free from Information Services, Agriculture Canada, Ottawa, Ontario K1A OC7.*

Concern about rising energy costs and their effect on food prices has led Agriculture Canada to provide a special energy publication.

This new pamphlet covers some of the major questions being asked about rising energy costs and some of the actions that can be taken to minimize their impact on agriculture.

Canada's food system, which includes farm production, processing, packaging, transportation, distribution, and home preparation, uses only 15 percent of all the energy consumed in Canada today. However, any rise in energy costs results in significant increases in farmers' costs and also in food prices for consumers.

A rise in price for crude oil affects prices for many farm inputs, including fuels, fertilizers, and pesticides. A $1/bb1 increase in crude oil could increase prairie wheat production costs $0.46 to $0.63/ac and grain corn costs in central Canada about $2/ac.

Food prices also increase directly as a result of changes in oil prices. The same $1/bb1 increase would result in a 0.35 percent increase in the food component of the Consumer Price Index.

The pamphlet outlines how the federal government is helping, on its own and in cooperation with the provinces, the private sector and individual farmers to further reduce farm energy needs.

Since 1974 the federal government has been funding research into alternative energy sources for agriculture. The projects have included solar heat collectors to help heat animal housing, wind generators, the use of industrial waste heat in greenhouses, and the production of fuel alcohol from various biomass sources.

The federal government has also allocated a total of $114 million to be spent under energy cost-sharing programs with the provinces and the private sector between 1979 and 1985.

Although this publication is directed to questions most often raised by the farming community, consumer and farmer alike will find it useful in explaining the current energy situation and how the agricultural industry can help reduce its energy needs.

Gatt Activities in 1980. *Available in English, French, and Spanish editions from booksellers or directly from the GATT secretariat, Centre William Rappard, 154, rue de Lausanne, 1211 Geneva 21. Price: Swiss Francs 12.00.*

Continuing efforts to open up world markets and to strengthen the international trading system, together with action towards settling a record number of trade disputes between GATT member states, are the main themes of *GATT Activities in 1980.*

This annual publication is aimed at those who need a comprehensive yet brief and clear source of reference on the whole range of GATT's activities over the past year. The report describes, for example, implementation of the various Tokyo Round trade agreements, new initiatives in the Consultative Group of Eighteen on the problems of world agricultural trade and of structural adjustment, action to promote the trade interests of developing countries, and the issues involved in negotiations within GATT during 1981 over the future of the Multifibre Arrangement (MFA).

World trade continues to be dynamic in the face of widespread economic adversity

The introduction to the report points out that 1980, for the world economy, was one of the most difficult years of the entire postwar era, with widespread inflation and unemployment, continuing monetary instability, and large payments imbalances. Inevitably, international trade was affected. In volume, it grew by barely 1 percent: in only two previous years (1958 and 1975) since the Second World War was the growth rate lower. Protectionist pressures are high in many countries, and international trade disputes have been numerous.

"Nevertheless", the report says, "the record of trade relations in 1980 is far from discouraging. The slackening in trade growth is clearly related to the state of the world economy as a whole rather than to deliberate action to close off trade flows. Trade in manufactures grew in volume by 3 percent, a markedly lower rate of growth than in 1979 (for which the comparable figure was 5.5 percent), but this was still triple the 1980 growth rate of world manufacturing output. The essential dynamism of international trade continues to be evident, even in unfavourable circumstances."

The GATT system of rules and cooperation still intact, indeed strengthened

The report adds that "as far as trade relations themselves are concerned, the essential fact is that the basic system of rules and cooperation within GATT remains intact, and in important respects was indeed strengthened in 1980". In January of that year, the greater part of the results of the Tokyo Round of multilateral trade nego-

tiations came into effect, reinforcing the existing rules, continuing the process of tariff dismantling that had been a central part of GATT's work throughout its 33 years of existence, and extending trade liberalization into new areas outside the field of tariffs.

"Over the following twelve months", the report continues, "an immense amount of effort was put by the GATT member governments into converting the Tokyo Round results from paper agreements into a living element in international cooperation. At the same time, the programme for future GATT work which had been drawn up at the end of the Tokyo Round was carried forward, with a strong emphasis on issues affecting trade of developing countries. There is every reason to expect these efforts to continue steadily in 1981."

Record number of international trade disputes brought to GATT for settlement is evidence of governments putting their faith in the GATT system

The report notes that it is GATT's role in dispute settlement which attracts most public attention. "The fact that the number of disputes brought before GATT in 1980 was the highest for many years is a clear reflection of present economic difficulties, and of the resulting pressures on governments either to restrict competition from imports or to assist exports by subsidies or other means. The disputes brought to GATT for settlement are evidence that the international trading system is under stress. But they are also evidence that governments are continuing to put their faith in the GATT rules and dispute settlement system as a basis for overcoming trade problems."

"The GATT rules, especially the procedures for conciliation and dispute settlement," the introduction concludes, "are even more important in time of economic difficulty than they are when the world economy is booming. When so many elements in the economic outlook – consumer demand, prices, exchange rates, technological development – are highly uncertain, it becomes vital that the contractual trade rules embodied in the GATT system remain stable and predictable. When disputes cannot be resolved bilaterally, it is essential that there be effective conciliation procedures in GATT, providing an agreed framework of international cooperation for dealing with trade conflicts."

Farm Voices. Gary Carlson. 120 pp. *Available for $5.00 plus $.50 for mailing (by cheque or money order) from the Saskatchewan Federation of Agriculture, P.O. Box 1637, Regina, Saskatchewan S4P 3C4 (Attention: History Book).*

Farm Voices is a prairie farm organization history and reference guide which includes descriptions of more than 200 prairie farm organizations and of 120 prairie farm leaders.

It documents the evolution of farm organizations from 1870 to 1980 and contains a chapter on Prairie Grain Cooperatives. In addition, the book describes the major U.S. farm organizations with which Canadian farm organizations work.

As an aid to researchers, it lists 132 references.

The following publications are available free from the Publications Manager, Regional Development and International Affairs Branch, Agriculture Canada, Room E-132, Sir John Carling Building, Ottawa, Ontario K1A OC5.

A Quarterly Forecasting Model for the International Wheat and Feed Grains Sector. The available working papers in this Food and Agriculture Regional Model (FARM) project follow.

Working Paper No. 1: Quarterly Canadian Feed Grains Forecasting Model, Version 1. S.N. Kulshreshtha, A.K. Banerjee, W.H. Furtan, and G.G. Storey.

Working Paper No. 2: Experimental Forecasts of Canadian Prairie Cereal Yields Based on Weather Data. G.D.V. Williams and R.G. Lattimore.

Working Paper No. 3: Grains and Oilseeds Supply Block of Food and Agriculture Regional Model. J.C. Lowe and T.M. Petrie.

Working Paper No. 4: A Quarterly North American Soybean Forecasting Model. K.D. Meilke and L. Young.

Working Paper No. 5: Quarterly Rapeseed, Rapeseed Oil, and Rapeseed Meal Forecasting Model. S.N. Kulshreshtha, A.K. Banerjee, W.H. Furtan, and G.G. Storey.

Working Paper No. 6: Econometric Analysis of the Canadian Regional Hired Farm Labor Market. Ramon Lopez and James MacMillan.

Working Paper No. 7: Prairie Grain and Oilseed Acreage Response. David Colman.

Working Paper No. 8: A Model of Australian Trade in Beef with North America. E.W. Goddard, L.J. Martin, and G. Griffith.

Working Paper No. 9: A Quarterly Forecasting Model of the Canadian Soybean Sector. Karl D. Meilke, Larry Young, and Dorothy Miller.

Working Paper No. 10: Specification and Evaluation of a Quarterly Forecasting Model for Grain and Oilseeds. S.N. Kulshreshtha, A.K. Paul Banerjee, W.H. Furtan, and G.G. Storey.

Working Paper No. 11: An Econometric Forecasting Model of the International Coarse Grains Market. R.J. MacGregor and S.N. Kulshreshtha.

Working Paper No. 12: Farm Income Block of the Food and Agriculture Regional Model (Version 1). F. Tung, W. Darcovich, F. Donkor, and D. Leung.

Working Paper No. 13: A Quarterly Forecasting Model for the International Wheat and Feed Grains Sector. Harry de Gorter and Ralph Lattimore.

The Apparent Nutritive Value of Food Available for Consumption in Canada, 1960-75. Linda Robbins and Sushma Barewal, Publication No. 80/6, March 1981, 146 pp.

Economics of Crop and Livestock Production in Saskatchewan, 1977 and 1978. M.M. Sorboe. Economic Working Paper No. 14.

Market Commentary – Animals and Animal Products. May 1981, 55 pp.

Market Commentary – Grains and Oilseeds. March 1981, 51 pp.

Market Commentary – Milk and Dairy Products. April 1981, 33 pp.

Selected Agricultural Statistics for Canada and the Provinces, 1981. Publication No. 81/2, bilingual, April 1981, 94 pp.

Structural Adjustment in the Ontario Farm Sector, 1971-76. J.R. Cumming, December 1980. Economic Working Paper.

The following publications are available free from the Economic Council of Canada, P.O. Box 527, Ottawa, Ontario K1P 5V6.

An Assessment of the Impact of the Federal Budget on the Canadian Economy. B.L. Eyford *et al.*, January 1981, 119 pp.

Inflation and Unemployment in Canada and Other Industrial Countries. Anne Romanis Braun, January 1981, 135 pp.

Intervention and Regulation in Canadian Agriculture: A Comparison of Costs and Benefits Among Sectors. Tim Josling, March 1981, 42 pp.

IN REPLY TO AUTHORS AND EDITORS REGARDING VOL. 16, NOS. 2-3, 1981

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8 Recent developments in economic data at Agriculture Canada *W. Darcovich*
12 Economics of crop and livestock production in Saskatchewan *M.M. Sorboe*
22 Economic indicators
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HON. EUGENE WHELAN, MINISTER
GAÉTAN LUSSIER, DEPUTY MINISTER

An economic analysis of alternative management techniques for beef production on irrigated pastures in Alberta

The economically optimum stocking rate for intensively managed pastures lies between the points of decreased individual rate of gain and maximum total animal weight gain per hectare. Net returns from grazing yearling steers are higher on irrigated legume pastures than on grass pastures because of savings in nitrogen fertilizer. It is more profitable to feed surplus spring forage growth, which is characteristic of the grass pastures, than to sell it as hay.

K.D. Russell, R. Hironaka, and D.B. Wilson

INTRODUCTION

In 1979, 8.3 percent of the 360 000 irrigated hectares in southern Alberta was used for tame pasture.[1] Many management systems exist for governing the use of tame pasture but the development of economically efficient management systems requires the matching of forage growth patterns, livestock requirements, and other physical and financial inputs. A large volume of experimental data on forage growth patterns and on the performance of feeder cattle under various feeding regimes is available at Agriculture Canada's Lethbridge Research Station. It should be feasible to use these biological data in an economic model to select the most economically desirable management systems.

[1] Alberta Agriculture 1980, *Agriculture Statistics Yearbook 1979*, Agdex 853-10.

The purpose of the project reported here was to combine the experimental animal and forage crop data in an economic analysis of feeder cattle production on irrigated pasture to:

1. compare animal weight gains and financial returns from grazing yearling steers on five forage species to determine optimum forage utilization, and
2. evaluate the relative profitabilities of constant and variable stocking programs for grazing steers.

MANAGEMENT CONSIDERATIONS

Determining the optimum stocking rate of a pasture is a complex task. One method is to use individual steer weight gain as a criterion of optimum performance. If weight gains are virtually unaffected as animals are added, the pasture is stocked below capacity. As more steers are placed on the pasture, they compete with one another for high quality herbage and eventually for quantity of feed intake. This is depicted by the 'beef gain per steer' shown in Figure 1. Stocking rates are often curtailed at the point where steers begin to compete for quantity of forage intake and the rate of gain per steer begins to decline (stocking rate A in Figure 1). Grazing at less than this intensity is usually considered undergrazing.

As more steers are placed on the pasture the rate of gain per steer declines, but total weight gain per hectare increases to a maximum 'total beef gain per hectare'. Beyond this point (stocking rate B in Figure 1) total

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Dr. Hironaka is an animal nutritionist at the Agriculture Canada Research Station, Lethbridge, Alberta.

Dr. Wilson is a pasture specialist at the Agriculture Canada Research Station, Lethbridge, Alberta.

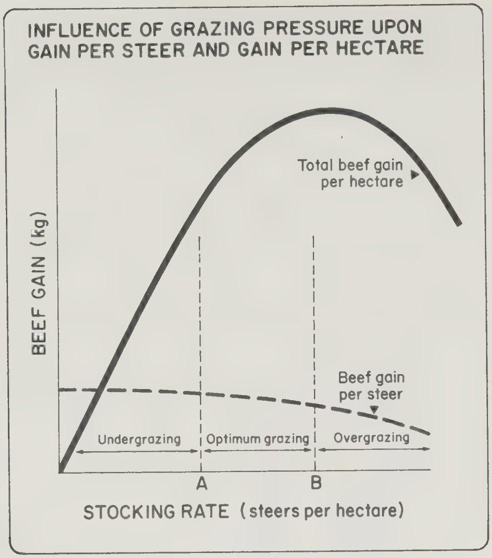


Figure 1.

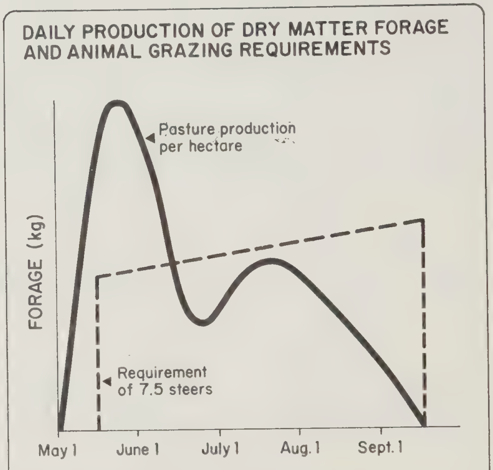
beef gain per hectare diminishes because a larger proportion of the available nutrients, from the forage, are used to satisfy the maintenance requirements of the increased number of animals. The point of maximum gain per hectare is sometimes depicted as the optimum point of production; however, this may not be the most profitable production level per unit of pasture.

With zero margin in the steer prices (selling price per kilogram equals buying price per kilogram), the economically optimum stocking rate theoretically lies between the point of decreased individual rate of gain and the maximum total steer weight gain per hectare (between points A and B in Figure 1). If the margin is negative, the optimum stocking rate will shift to the left (A in Figure 1). If the negative margin is large, animals will not be purchased for grazing. If the margin is positive, the optimum stocking rate will shift to the right (B in Figure 1). If the positive margin is sufficiently large or is large and increasing over time, greatest short-term net profit may be obtained by overgrazing (stocking rates to the right of B in Figure 1). However, since overgrazing may be harmful to future forage production, the practical upper stocking rate is near point B.

Grass growth, compared with the herbage requirements of a constant number of grazing steers, is irregular throughout the growing season (Figure 2). A constant stocking rate may be inefficient since an early season flush of grass growth matures and becomes unacceptable to the grazing animals before it can be used. Also, regrowth may be inhibited later in the season. However, excess forage produced in early summer may be grazed off by additional animals, harvested for sale, or harvested to be fed back later in the season. The cost of using this excess forage is an important concern when comparing financial returns from the various forages. Management alternatives available for using the extra early summer growth on grass pastures include a modified variable stocking strategy and a constant stocking strategy.

The constant stocking strategy dictates that the same number of steers must be held throughout the grazing season as long as it is profitable to keep the entire group on pasture. As soon as it becomes unprofitable to keep the steers on the pasture, the entire group is removed. If a constant stocking strategy is used, the extra spring growth is harvested as hay and either fed back to the steers later in the season or sold as hay.

The modified variable stocking strategy allows some of the steers to be removed during the grazing season as the feed supply becomes scarce and it is no longer profitable to keep the entire group of steers on the pasture. A maximum number of steers to be grazed is placed on the pasture in the spring and when a steer is removed it cannot return to the pasture later in the season.



Source. *Irrigated Pastures for Cattle in Western Canada*, Agriculture Canada Publication 1526, 1974

Figure 2.

MATERIALS AND METHODS

Biological Experimentation and Data

Biological data were obtained from plant and animal experiments conducted at the Agriculture Canada Research Station, Lethbridge, Alberta. An irrigated pasture grazing trial was conducted during the period 1966-77. Plots of 0.45 ha were divided into four paddocks for rotational grazing. Each plot was replicated three times, though only one replication was seeded per

TABLE 1. USABLE DRY MATTER PER GRAZING PERIOD (KG/HA) AND DIGESTIBLE ENERGY (KCAL/KG) OF FORAGE PER GRAZING PERIOD

Forage		Period[a] 1	2	3	4	5	6	7	Total Production
Kentucky bluegrass	(kg/ha)	217	1438	1519	852	878	649	103	4332
	(kcal/kg)	2287	2098	2144	2062	2408	2198	2069	
Reed canarygrass	(kg/ha)	13	1593	2131	1039	1158	881	22	5363
	(kcal/kg)	2753	2563	2465	2433	2389	2372	2433	
Orchardgrass	(kg/ha)	131	1431	1702	966	1174	949	80	5189
	(kcal/kg)	2538	2423	2248	2286	2223	2215	2214	
Sainfoin	(kg/ha)	72	792	1167	1022	666	688	239	4646
	(kcal/kg)	2771	2607	2466	2336	2450	2384	2601	
Cicer milkvetch	(kg/ha)	0	649	1359	1362	992	274	0	4636
	(kcal/kg)	–	2771	2788	2762	2692	2574	–	

[a]Periods were: 1) May 15-21; 2) May 22-June 11; 3) June 12-July 2; 4) July 3-23; 5) July 24-Aug. 13; 6) Aug. 14-Sep. 3; and 7) Sep. 4-24.

year. The purpose of staggered seeding was to maintain flexibility in establishing new treatments and deleting old ones. The normal expectation for a treatment was to accumulate nine plot-years of observations. The plots were sown to pure stands of grasses–orchardgrass, Kentucky bluegrass, or reed canary grass; or to legumes–sainfoin or cicer milkvetch.

Yearling cattle (Hereford or Hereford cross), with an average initial weight of 285 kg, were purchased in the spring and assigned to a plot for the season. The grazing rate, 7.5 hd/ha, was selected so that the amount of forage grazed would approximate the total forage growth. If the forage supply became inadequate during the season, all cattle were removed from a plot and maintained on spare pasture until sufficient regrowth had occurred to resume grazing. The cattle were weighed at 2-week intervals throughout the season.

Forage dry matter availability and disappearance were measured by cutting samples of the forage on the days when animals were moved into and out of a paddock. Excess feed was available to the animals at all times. When grass growth exceeded immediate needs and was advanced in maturity after the spring peak growth period, one of the paddocks was cut for hay on about June 15. It was unnecessary to harvest the legume pastures as they did not become too mature before they were required for grazing.

The basic assessment criteria in this trial were 1) average daily gain (ADG) of yearling steers, 2) weight (kg) of dry matter disappearance from the pasture for each unit of weight gain (kg) by the steers, and 3) weight (kg) of dry matter disappearance per head per day. In vitro digestibility of the forage was determined from samples taken at regular intervals during the season, and many subjective measurements were recorded. The small size of the plots and the management systems used limited the accuracy of productivity assessment per unit area of pasture. These data were used to estimate forage supplies for the various management practices analyzed in this study. Accumulated dry matter and digestible energy for the five pastures were initially low, peaked during the last half of June or early July, then gradually decreased as daily consumption surpassed daily production until the latter part of September when grazing was terminated (Table 1).

The rate of expected gain, protein requirements, and the expected dry matter intake for yearling steers were calculated from feeding trial data at the Lethbridge Research Station or derived from literature values. The equations for rate of expected gain were based on data in which steers were fed all concentrate or concentrate and cubed hay diets.[2] The mathematical functions, described in the previous reference, relating gain to steer weights and digestible energy (DE) intakes per day were:

1. for steers weighing between 270 and 349 kg
   $G = -6.15 + 2.98 \log_{10} (DE/W^{0.75})$,
2. for steers weighing between 350 and 475 kg
   $G = -8.17 + 3.80 \log_{10} (DE/W^{0.75})$,

where G = daily gain per day (kg),
DE = digestible energy consumed per day by the steer (kcal), and
W = weight of the steer (kg).

[2]R. Hironaka and G.C. Kozub, "Estimation of Digestible Energy Requirements for Maintenance and Gain in Hereford Steers Fed All Concentrate Diets," *Proceedings, Western Section, American Society Animal Science* 31 (1980): 226-227.

The protein requirements were based on values calculated for steers of different weights gaining at different rates.[3] However, the protein content of the forages should be high enough that protein intake would not be a limiting factor restricting growth rate.

Maximum feed intake is governed by rumen fill of bulky feeds. For steers fed a high roughage diet, intake as measured by kilograms of air dry feed was estimated as $0.105W^{0.75}$ where W is the weight of the steer (in kilograms).[4]

Model Description

A computer simulation model was developed to compare the cash costs and returns of various stocking rate scenarios for given pasture sources. The question of stocking rates on irrigated pasture is assumed to be independent of the pasture systems' relationship to production on the rest of the farm. Cash costs and returns, based on financial data outlined in the Appendix, are calculated for each feasible stocking program. Net returns for each stocking scenario on each pasture source are compared with those from other scenarios; the one with the highest net return per hectare is selected and displayed. By determining the net returns for various pasture combinations, supplemental feed sources, and grazing rotations, expected maximum net return grazing strategies can be determined.

The grazing season is divided into seven grazing periods of about 20 days, which coincide with different phases of pasture growth (see Appendix).

The simulation model tallies and records the total quantity of digestible dry matter available in each period. The available dry matter is divided among the grazing animals by their ability to consume the forage. If the available forage is limited, it is divided equally among the animals. When all the available feed is not utilized in one period and when the same type of feed is available in the next period, a specified portion of the unused feed can be transferred into the next period. If no pasture forage is available during the first period (May 15 to May 22), the steers are held over at zero daily gain for that period at a fixed daily cost.

Animal gains are calculated in the model by means of one of the two daily gain formulas. The appropriate formula is selected on the basis of animal weight.

The model can simulate a modified variable stocking program or a constant stocking program. For both programs, the maximum number of steers to be grazed is purchased at the beginning of the first period (May 15).

Method of Analysis

Stocking rates that resulted in the highest net return for given pasture supplies and cost data were selected by the simulation model for each pasture. Three grass pastures (Kentucky bluegrass, reed canarygrass, and orchardgrass) and two legume pastures (sainfoin and cicer milkvetch) were evaluated. These pastures were monitored in the irrigated pasture grazing trial. The quantity and quality of each pasture forage are listed in Table 1.

Net returns were based on the gross receipts for the steers less steer and pasture costs. Steer costs included: interest on the cattle inventory, marketing costs for buying and selling cattle, purchase costs of the steers, holding costs over the first grazing period if pasture is not available for that period, and daily steer overhead costs. Pasture costs include: pasture establishment, fencing, irrigation, taxes, water rights, fertilizer, herbicide, and labor costs. Steer and pasture costs were based on the 1979 grazing season and are outlined in the Appendix.

Steers were purchased in the spring at 275 kg live weight and were grazed to about 350 kg live weight if they were kept through the grazing season. The 180 to 290 kg steers and the 290 to 350 kg steers represent different cattle markets. It was assumed that a steer progressed from the light feeder market into the heavy feeder market at a constant rate through the grazing season and did not change markets at the arbitrary weight of 290 kg. Edmonton-based prices for steers were weighted to represent a gradual shift between the two markets. The weighted steer prices were averaged from 1972 to 1979 to modify the seasonal steer price scenario for yearly cycles in the cattle market (see Appendix). All steers were purchased May 15 for $1.22/kg plus a fixed marketing cost. Steers were sold throughout the grazing season at the appropriate market price plus a fixed marketing cost.

To determine the influence of general market conditions on optimum stocking rates, highest net return stocking rates were also determined for steer price scenarios at 50 and 150 percent of the above steer price scenario. Factors affected by market conditions are: 1) interest costs on the steer inventory which is 50 percent lower for the 50 percent steer price scenario, 2) gross returns are also 50 percent lower, and 3) the margin between the selling and purchase price is smaller. The opposite situation is true for the 150 percent price scenario.

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[3]R. Hironaka and B.H. Sonntag, *Feedlot Finishing of Cattle* (Agriculture Canada, Publication 1591, revised 1981).

[4]R.L. Preston, "What is needed to 'break through' the efficiency barrier in beef cattle?" *Feedstuffs* 40 (1968): 20-22, 24, 52.

TABLE 2. OPTIMUM STOCKING RATES FOR IRRIGATED PASTURE

Forage[a]	Stocking Rate During Season		Number of Periods Grazed	Total Gain	Net Return
	Highest	Lowest			
	steers/ha	steers/ha		kg/ha	$/ha
Kentucky bluegrass	6	3	7	497	26
Reed canarygrass	5	5	7	545	81
Orchardgrass	7	4	7	628	120
Sainfoin	4	3	7	492	183
Cicer milkvetch	4	4	5	570	172

[a]Assumptions: All forage is grazed (none is harvested) and modified variable stocking rate is used.

Two management strategies were used to increase the profitability of the pasture feeding enterprise—manipulating pasture supplies or steer numbers, or both, during the grazing season. The constant stocking rate management strategy considered for the three grass pastures included harvesting excess pasture growth as hay early in the season and either feeding it back to the animals later in the grazing season or selling it as hay. Both options were simulated for the three grass pastures. When the early spring growth was harvested, one quarter of the available forage supply was removed from periods one and two. This same amount of feed was fed to the animals in periods five and six, or sold. The digestibility value for the hay was reduced slightly from that assigned the standing grass at the time of harvest. The constant stocking rate management strategy for the two legume pastures did not include harvesting the extra spring growth.

The modified variable stocking rate management strategy included two options for the grass pastures. One option was to cut for sale the same amount of early spring forage growth as was practiced in the constant stocking strategy. The other option was to graze the flush of spring forage growth with extra animals. Only the latter option was applicable to the legume pastures.

Net returns, total animal gain per hectare, and stocking rates were compared for the five pastures for each of the applicable management strategies.

RESULTS

Optimum stocking rates for maximum net returns varied from a high of seven animals per hectare for orchardgrass during the first part of the grazing season to a low of three animals per hectare on sainfoin and Kentucky bluegrass for the last part of the grazing season (Table 2). Optimum stocking rates were as low or lower for legumes than for grass pastures. These results are based on the assumption that all of the pasture production is grazed using a modified variable stocking rate. Optimum stocking numbers remained constant or increased as the steer price scenario was increased from 50 to 150 percent of the Edmonton prices. This reflects a move towards B in Figure 1 as the price of steers increases.

Orchardgrass pasture had the highest total seasonal weight gain per hectare at 628 kg. Total weight gain on sainfoin, 492 kg, was marginally lower than on Kentucky bluegrass.

Net return per hectare for the five pasture sources under optimum grazing strategies ranged from $26 for Kentucky bluegrass to $183 for sainfoin. Both legume forages resulted in a higher net return than the grasses. The grasses were longer lived but the legume pastures required no nitrogen fertilizer. Nitrogen fertilizer was applied to the grass pastures in accordance with the current extension service recommendation of 224 kg N/ha.

Constant stocking rates and modified variable stocking rates were the management techniques compared for the legume pastures (Table 3). Net returns decreased by $32/ha if steers were kept on the sainfoin pasture with a constant stocking rate strategy rather than the modified variable stocking strategy. There was no difference in weight gain or net return between the modified variable and constant stocking strategies for cicer milkvetch.

Of the four alternative management systems for orchardgrass pastures, the modified variable stocking rate strategy with the excess spring growth grazed by extra animals early in the season, was the most profitable strategy (Table 4). This strategy did not result in the highest total beef gain per hectare. A constant stocking program with the excess spring growth harvested and fed back to the animals later in the season as hay, gave the highest beef gain per hectare for all three grass pastures and was the most profitable strategy for all grasses except orchardgrass (Table 5).

TABLE 3. A COMPARISON OF MANAGEMENT STRATEGIES FOR SAINFOIN

Item	Stocking Rates	
	Modified Variable	Constant
Net return ($/ha)	183	151
Highest stocking rate during the season (animals/ha)	4	3
Lowest stocking rate during the season (animals/ha)	3	3
Number of periods grazed	7	7
Total gain per hectare (kg)	492	430

DISCUSSION

The forage that produces maximum beef production per hectare is not necessarily the forage that will be the most profitable. Comparing grasses and legumes, the cost of nitrogen fertilizer, which is needed for grasses but not for legumes, may be a major factor in determining the net returns. Using the pasture costs as outlined in the Appendix, and with the nitrogen applied in four increments throughout the pasture season, the grass pasture cost $105/ha more than the legume pasture. Without the difference in fertilizer costs, net returns for orchardgrass and reed canarygrass would have been competitive with the legume pastures. However, without the fertilizer, the production of the grass pasture would have been reduced. The level of nitrogen fertilizer (224 kg/ha) is a single estimate based on extension service recommendations for stable market conditions and on a limited knowledge of a forage response function to nitrogen fertilizer. The economic optimum level of nitrogen use for irrigated grass pastures is unknown and a reduction in nitrogen fertilizer may be profitable. Further effort is needed to develop grass response functions to fertilizer applications.

Another factor contributing to the higher net returns from legumes was their higher digestibility. For example, a 275 kg steer consuming 7 kg of 2788 kcal/kg sainfoin forage will gain 1.2 kg/d. The same steer will gain only 0.9 kg/d with 2248 kcal/kg grass forage.

Total levels of herbage production for the five pastures studied were not directly related to profitability. This is not unreasonable since desirable pasture characteristics are a combination of herbage yield, quality, and the distribution of production throughout the grazing season.

TABLE 4. A COMPARISON OF MANAGEMENT STRATEGIES FOR ORCHARDGRASS

Item	Stocking Rate			
	Modified Variable		Constant	
	All Grass Grazed	Extra Grass Sold As Hay[a]	Extra Grass Fed As Hay	Extra Grass Sold As Hay[a]
Net return ($/ha)	120	56	110	77
Highest stocking rate during the season (animal/ha)	7	5	6	4
Lowest stocking rate during the season (animal/ha)	4	4	6	4
Number of periods grazed	7	7	7	7
Total beef gain per hectare (kg)	628	520	645	472

[a]Grass hay is sold for $72/t and harvesting costs are $18/t.

TABLE 5. NET RETURNS FOR MANAGEMENT STRATEGIES FOR GRASS PASTURES

Forage	Stocking Rate			
	Modified Variable		Constant	
	All Grass Grazed	Extra Grass Sold As Hay	Extra Grass Fed As Hay	Extra grass Sold As Hay
	$/ha			
Kentucky bluegrass	26	−31	38	−22
Reed canarygrass	81	18	91	57
Orchardgrass	120	56	110	77

The generally higher profit found in the management strategy of cutting part of the forage from the fast growth in spring and feeding it back later is not surprising. Some operators now cut one crop of hay for winter feed and pasture the second crop rather than reducing cattle numbers. This strategy is a modification of the alternatives of this paper in that the crop is primarily a hay crop but serves the same purpose as cutting one field for hay instead of pasturing it. Since the price of fed cattle ready for slaughter is generally higher than for heavy weight feeder cattle; having more land available for grazing late in the season when steer requirements are high, because of their large size, may have an added economic benefit. The feeding of grain as forage yield declines is another alternative to selling cattle before they are ready for slaughter. This practice would provide another option to analyze for increased profit from grazing cattle.

CONCLUSIONS

The two legumes tested produced higher net returns per hectare on irrigated land than did grass pastures. This resulted from the higher digestibility of the legume pastures and the savings in nitrogen fertilizer applications. Total production of herbage throughout the grazing season did not directly affect the ranking of the five pasture species. It is more profitable to feed the flush of spring growth, which is characteristic of the grass pastures, than to sell it as hay for $72/t.

Modified variable stocking strategies, where feasible, result in an increase in net return for orchardgrass, cicer milkvetch, and sainfoin pastures over constant stocking strategies. The increased net returns vary by forage type.

APPENDIX

Budget Data

GRAZING PERIODS

Period	Dates	Steer Price ($/kg)[a]
1	May 15 May 21	1.22
2	May 22 June 11	1.25
3	June 12 July 2	1.27
4	July 3 July 23	1.26
5	July 24 Aug. 13	1.24
6	Aug. 14 Sep. 3	1.17
7	Sep. 4 Sep. 24	1.23 1.23

[a]Buying costs of $10 per steer and selling costs of $15 per steer are not included.

DAILY OVERHEAD COSTS

	$/steer[a]
Salt, minerals, and vitamins	0.05
Veterinary and medicine	0.05
Misc. (ear tags, warble control, etc.)	0.05
Labor	0.10
Interest on cattle inventory (15%)	0.14

[a]The additional costs of holding a steer during period 1, if pasture is unavailable, is $1.10 per day.

PASTURE COSTS

		$/ha
Grass pastures		
Pasture establishment	$114.47	
Fencing	133.20	
	247.67	
Amortization for 20 years at 15% interest		$ 39.58
Yearly grass pasture costs		
Irrigate	40.62	
Fertilize	132.34	
Taxes and water	18.89	$191.85
Herbicide costs (2,4-D)		
Creeping red fescue and Kentucky bluegrass	4.80	$ 4.80
Orchardgrass and reed canarygrass	1.60	$ 1.60
Legume pastures		
Pasture establishment	$114.47	
Herbicide (treflan)	23.58	
Fencing	133.20	
	271.25	
Amortization for 5 years at 15% interest		$ 80.91
Yearly legume pasture costs		
Irrigate	40.62	
Fertilize	27.00	
Taxes and water	18.89	$ 86.51

Recent developments in economic data at Agriculture Canada

Agriculture Canada, in cooperation with Statistics Canada, provides relevant data for all areas of the food system. The Food-at-Home Price Index and the Nutritious Food Basket concept furnish food price information to consumers, making it possible for them to purchase nutritious food at a moderate cost. The extension of forecasting capabilities and data support has increased the flow of economic intelligence and basic information for policy and program analysis.

W. Darcovich

INTRODUCTION[1]

Agriculture Canada has recently completed a series of reorganizations that will undertake regional and market development and orient departmental priorities to the food system and away from the farm sector. The reorganizations underlie some of the recent developments at Agriculture Canada. This article deals specifically with developments in the provision and expansion of economic intelligence and in particular, those projects jointly undertaken by Agriculture Canada and Statistics Canada.

[1] This article is a slightly modified version of a paper delivered to the Western Agriculture Statistics Conference held in Banff, Alberta, January 1981. The author wishes to thank colleagues at Agriculture Canada B. Huff, Z. Hassan, L. Brink, I. Furniss, I. Willsher, H. Migie, F. Tung, P. Stone, D. Leung and J. Leblanc-Cooke and E. Boyko, G. Andrusiak, M. Trant and G. Lennox at Statistics Canada for their assistance and many helpful comments in the preparation of this paper.

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INCREASE IN FOOD MARKET INTELLIGENCE[2]

In June 1979, responsibility for the Agriculture Canada Food-at-Home Price Index and Agriculture Canada Nutritious Food Basket was transferred to Agriculture Canada from the Anti-Inflation Board. Both were revised in 1980 to broaden their scope and provide more meaningful data to the public. A new quarterly departmental publication, *Food Market Commentary*, was first published in 1979.

The *Food Market Commentary* provides commentary on food prices, expenditures, and consumption.[3] It also features current food related articles for those interested in food market information.

Agriculture Canada's Food-at-Home Price Index is the equivalent of the Food-at-Home component of the Consumer Price Index (CPI) produced by Statistics Canada. The Food-at-Home Price Index differs from the CPI Food-at-Home component in two major ways:

1. food prices are surveyed weekly rather than monthly, allowing for closer monitoring of volatile prices on perishable commodities such as fruits and vegetables,
2. the price index is released two rather than six weeks after its price survey.

Weekly pricing and timely release, enable Agriculture Canada to use the data in a number of ways. In particular:

1. to monitor, analyze, then report food price movements and spreads in the monthly *News Release* and the quarterly *Food Market Commentary;*
2. to calculate farm-to-retail and wholesale-to-retail price spreads for several food items at the national and regional levels (at present, price spreads are being calculated for beef, chicken, turkey, and eggs);
3. to calculate, for various cities, the average cost of the Nutritious Food Basket.

[2] Based on: S. Barewal, "Agriculture Canada's Food-at-Home Price Index", pp. 28-33; L. Robbins and M. Zarkadas, "The Agriculture Canada Nutritious Food Basket," pp. 34-42, *Food Market Commentary*, Agriculture Canada, 2 (December 1980).

[3] Available from the Economic Information Section, Agriculture Canada, Room E132, Sir John Carling Building, Ottawa, Ontario, K1A 0C5, 613-995-9554 (283).

The Agriculture Canada Nutritious Food Basket concept was developed to determine the cost of a nutritionally adequate diet for Canadians. The 84 items included were chosen for their nutritional content and moderate to low cost. The basket was developed after studies revealed that most Canadians were spending more for food than was necessary for a nutritious diet,[4] and yet, were not purchasing the appropriate food items.[5] The inference is that if Canadians were to use the nutritious food basket as a guide to food purchases, they would pay less for their food and would experience improved health. The situation is analogous to that found in farming where a gap exists between technology available and that which is actually utilized by farmers. For consumers there was shown to be 'nutritional gap' which it would be advantageous to close.

The cost of the nutritious food basket is calculated weekly, enabling weekly and monthly comparisons of the changing cost to Canadians of a nutritious diet. The figures also provide information on food prices and quantities which should help consumers purchase, at a moderate cost, food sufficient to meet nutritional requirements.

Agriculture Canada's contribution in producing these two sets of series is in part that of continuing projects initiated by agencies that no longer exist. A more important aspect of Agriculture Canada's contribution is that of having revised the series and having provided to consumers and producers, in line with the food system orientation, more meaningful and objective information on food prices and costs.

FORECASTING

Several developments are underway which are intended to complement and improve existing forecasting capability, and to increase the departmental flow of economic intelligence.

Short-Term Forecasting

Short-term forecasts are defined as forecasts up to two years forward.

The Food and Agriculture Regional Model (FARM) is an econometric model which is being developed to provide short-term quarterly forecasts of the prices, production, stocks and trade of farm commodities, retail food consumption and prices, farm net incomes, crop yields, and other variables for the farm and food system. The model is being used on a regular basis to support Agriculture Canada's Outlook program. A series of technical reports and working documents on FARM has been prepared.[6] The data for the model, called FARMBANK, can be obtained on-line through the Conference Board of Canada or Datacrown.

Statistics Canada has had the major responsibility of preparing the farm income forecasts, with Agriculture Canada providing a supporting role.

Since 1979, however, Agriculture Canada's input into farm income forecasting has been increasing. It now provides an independent forecast of farm net income, based in part on the methodology developed for the Ministry of State for Economic Development (see medium-term forecasting) and in part on forecasts from FARM cash receipts and expense equations. The Agriculture Canada forecasts serve as a basis for consultation and comparison. Statistics Canada forecasts are then revised, adjusted or modified where necessary.

In the summer of 1980, Agriculture Canada collaborated with Statistics Canada to inaugurate a mid-year update of the farm income forecasts from the Outlook Conference of the previous December. Released jointly by Statistics Canada and Agriculture Canada it is expected that the joint update will become a permanent feature of the farm net income forecast.

Agriculture Canada now presents a paper on farm income at the Outlook Conference. The paper deals with issues relevant to farm-generated income: inflation, sources and levels of off-farm income, farm income by farm type, prices and supplies of farm inputs, farm wealth, and farm welfare. It complements the farm income forecast paper presented by Statistics Canada.

Medium-Term Forecasting

Medium-term forecasts are defined as forecasts up to 5 years forward.

Medium-term forecasts have periodically been prepared by Agriculture Canada in response to requests by the Ministry of State for Economic Development and internal planning needs. Estimates (to 1985) of farm prices, production, cash receipts, expenses, and realized net income, which are the main components of requested forecasts, are made by using a composite of the forecasts from departmental economists and from the forecasting equations of FARM. The forecasts are being updated regularly for the first two years of the five-year period. This provides a second source of farm income estimates for the Outlook Conference and for the mid-year update.

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[4] Food Prices Review Board, *What Price Nutrition,* 1975.

[5] *Nutrition Canada Survey,* 1970 to 1972.

[6] *FARM: Food and Agriculture Regional Model,* Parts I to V, Information Services, Agriculture Canada, March 1980; *Economic Working Papers,* Nos. 1 to 12, related to Food and Agriculture Regional Model, Agriculture Canada, Ottawa.

World Agricultural Model

Arising in part from its work with FARM, Agriculture Canada is participating in an international project initiated by the International Institute for Applied Systems Analysis (IIASA). The project involves a series of about 25 linked country models developed by either IIASA staff or country teams. The model is designed to answer resource allocation questions for major inputs, marketing and food policy issues, and trade analysis. Canada will have access to data and models from a number of countries.

DATA SUPPORT FOR POLICY AND PROGRAM ANALYSIS

Type and size of farm budgets have not been regularly available to provide answers to such basic questions as: What are the effects of fuel price, interest rate, or grain price increases on farmers' incomes? Which farm types or sizes and which provinces will be most affected? These and similar questions are frequently posed but representative and up-to-date data have not been available to provide the answers.

In an effort to provide such answers, a project is underway which will derive representative farm budgets from a probability sample of some 18 000 farms from Statistics Canada's Farm Enumerative and Agriculture Enumerative Surveys (FES and AES).

According to a typology developed by Statistics Canada and Agriculture Canada, the initial budgets will be for seven or eight major farm types, representing Eastern and Western Canada for 1979.

The project is developmental, but when completed it will provide representative and updated types of farm budgets, for income impact analysis, from FES and AES data. More classifications and detail will be introduced over time.

Dairy cost studies based on CANFARM data are being extended to Quebec. In the last few years, Agriculture Canada has participated in an Ontario Dairy Farm Accounting Project, a probability sample of about 150 farms, using CANFARM to obtain and process the data. The study is expected to be extended to include Quebec. Initially it will use data from an existing provincial dairy accounting project. It is expected that a probability sample of dairy farmers, similar to Ontario's, will be developed using CANFARM. The studies will monitor dairy production costs in both provinces and verify the weights for operating expenses in the Dairy Target Returns Adjustment Formula.

Performance indicators for farm sector development are being prepared through an Agriculture Canada project to help monitor developments in the farm sector and guide development planning. A performance indicator may be defined as a statistical series which is related to a farm development goal; over time, such a series will indicate how well a relevant goal is being achieved. By 1982, between 50 to 100 indicators, monitored over various lengths of time, are expected to be ready for release to a select audience. The set of indicators would be comprised of, among other things, crop yields representing one group of indicators or trends in technical farm productivity; farmer net income and net worth series indicating the changing level of farmer welfare; and measures of stability over time in various price, quantity, and income variables.

OTHER DATA DEVELOPMENTS

Indexing of sales in the agricultural censuses will be incorporated in the 1981 census. A sharp rise in farm prices in the early seventies, made the sales classifications in the 1976 census meaningless when compared with corresponding classifications in earlier censuses. To correct the problem, Agriculture Canada and Statistics Canada have agreed to index sales classifications in the 1981 census to make them comparable with earlier censuses. A recent issue of *Canadian Farm Economics*[7] contains a number of census variables classified by indexed sales classes (in constant 1975 dollars) for the 1966, 1971, and 1976 censuses.

Expanding energy research and development for the agriculture and food system in the 1980s is a high priority with Agriculture Canada. There will be a substantial increase in the person-years devoted to this work. It is expected that contract funding for energy research and development, through various federal government programs, will be increased. The increased resources will strengthen Agriculture Canada's capability to deal with the problems faced by the agriculture and food system in adjusting to the new energy regime. At the same time, there will be an increased demand for more and improved energy data, which will have to be met if problems are to be clearly articulated and solutions proposed.

A detailed classification of part-time farmers, based on data from 1978 tax returns, has been developed and compilation is now underway. It should provide more information on this heterogeneous and complex group of farmers, whose only common feature is that most of their income is from sources other than farming. To obtain more homogeneous classes, part-time farmers will be classified by source and size of off-farm income; and by sex, age, and family size. While far from ideal, the classification should enhance our knowledge of the financial situation, welfare and composition of this

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[7] W.D. Jones and C. Buckley, "Measuring Structural Change in Canadian Farm Industry," *Canadian Farm Economics*, 15 (December 1980): pp. 9-34.

large and growing component of the farm sector. The study, if continued, could establish trends for various types of part-time farmers.

The Farm Development Division, Agriculture Canada, has initiated a series of reviews of the management practices used in farm production. Swine production has been reviewed, a review of feed grain production in the Maritime provinces in underway, and additional commodity reviews are planned.

The swine production management review considers farrowing, farrow-to-finish, and finishing enterprises. Practices include feeding, breeding, herd health, engineering, and business management. About 75 groups from accross Canada have cooperated in preparing the review. They include swine specialists, veterinarians, marketing board representatives, feed industry personnel, and producers. The review has been completed and contains regional data, by type of enterprise, showing the extent to which the various swine production management practices are used.

Although the reviews are not based on random sampling and also omit information on enterprise costs, they will provide Agriculture Canada with insights to facilitate program planning and development for many important industries. The reviews will also provide information that will be useful for other participants in the industry, such as extension staff, who aim to improve management practices at the farm level.

A farm credit survey is being carried out by the Farm Credit Corporation, with the involvement of the Farm Development Division. Approximately 5 000 farmers were surveyed concerning their present financial credit situation: amounts, sources and terms of credit; values and types of assets and investments; and intentions for next year. The survey was completed in April, and the results are expected to be available later in 1981.

The overall objective of the survey is to provide data on credit and investment needs of farmers. This expanded data will be used by the Farm Credit Corporation to seek extra sources of funding to more adequately serve its clients. Agriculture Canada will be particularly interested in the information on intermediate term credit, such as Farm Improvement Loans.

Changes have occurred in the Market Information Service. During 1980-81, there has been some expansion in the livestock information program. Data gathered by industry associations, specifically daily direct-to-packer cattle prices and weekly by-product prices by the Canadian Cattlemen's Association, have now been included in Agriculture Canada's national package of market statistics.

The Canadian Poultry and Egg Processor's Council criticized the use of simple average prices in the wholesale to retail price quotation system. After considerable negotiation the system has been modified and reinstated with council members providing a weighted average price quotation.

A shift to electronic assembly and dissemination of departmental market information data will be phased in over a 5-year period. To meet this objective, a feasibility study is underway to develop electronic procedures which will provide market information on livestock and meat products. In the future, similar systems will be implemented for poultry, fruit, vegetables, dairy, and special crops.[8]

CONCLUSION

This outline of data developments at Agriculture Canada is not exhaustive. The developments inventoried here are considered to be high priority activities. Some are already providing, and others have the potential of providing, an increased flow of intelligence for policy analyses and research in the food system.

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[8] I. Willsher, "Notes: Market Information Services," *Canadian Farm Economics,* 15 (December 1980): p. 37.

Economics of crop and livestock production in Saskatchewan

In 1977 and 1978 a CANFARM sample of Saskatchewan farms was surveyed to obtain representative data on crop production. The data indicated an apparent increase in farm size, a shift to more wheat and rapeseed acreage, and a substantial increase in net farm income for 1978.

M. M. Sorboe

INTRODUCTION

Subsequent to the enactment of the Western Grain Stabilization Act (WGSA), in 1976, a CANFARM sample of Saskatchewan farms was surveyed to obtain representative financial data on crop production. The data were used primarily to analyze the variation in cash expenses on western grain farms. This paper presents the analysis' highlights of 715 farm financial records for 1977 and 718 for 1978.

The CANFARM sample was designed to be statistically representative of the total farm population of grain producing farms in Saskatchewan. Except for a few replacement farms, substantially the same farms were surveyed in each of the 2 years.

Beyond analyzing cash expenses the data have been useful in estimating costs, returns to land, and other farm input resources.[1] Moreover, they served as the basic data source for an article[2] and a working paper[3] which gives considerably more detail on costs, returns, assets, and liabilities by farm type, size, and soil productivity. Researchers, farm managers, and management specialists might find the working paper useful. However, an update of the data would be necessary to simulate the current situation.

[1] *PFRA Pasture Fee Study* (Ottawa: Agriculture Canada, 1979).

[2] M. M. Sorboe, "Problems in Estimating Farm Production Costs," *Canadian Farm Economics* 15 (October 1980): 17-24.

[3] M. M. Sorboe, *Economics of Crop and Livestock Production in Saskatchewan 1977 and 1978*, Economic Working Papers, no. 14 (Ottawa: Agriculture Canada, June 1981).

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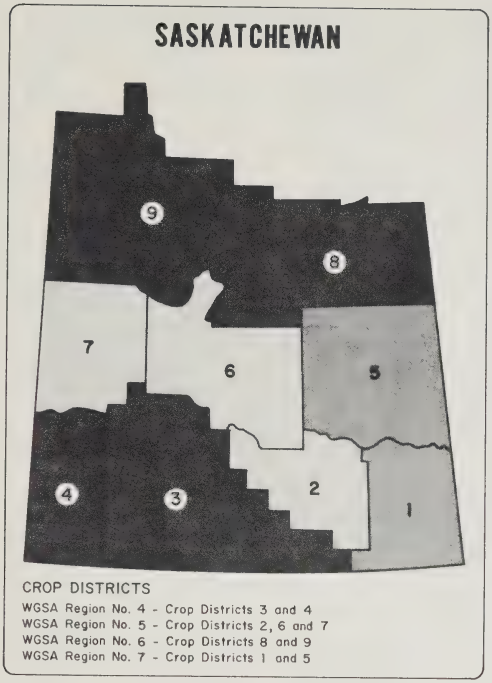
DESCRIPTION OF THE REGION

The farming area of Saskatchewan was divided into four distinct regions, primarily on the basis of natural soil characteristics: Region 4, southwest, representing the brown soil; Region 5, central, representing the dark brown; Region 6, north-central, and Region 7, southeast, representing black and degraded black parkland soils.

Region 4, brown soils occupy the short-grass prairie and the adjacent section of mixed-grass prairie. This is the most arid part of the province, characterized by prairie grassland vegetation, the absence of trees, and frequent droughts. The cultivated lands are used mainly for grain production, the non-arable lands for cattle grazing. Brown soils have light or grey brown surface horizons which are generally thinner and lower in organic matter than those of other grassland soils.

Region 5, dark brown soils represent a transitional stage between brown and black soils. In nature and agricultural adaptation they more closely resemble the brown soils but are richer in organic matter and produce a denser cover of prairie grasses, interspersed with small groves of trees and shrubs. Most of the land in the region is used in the production of cereal grains and oilseed crops. Non-arable and marginal grain lands are used for producing cattle.

Region 6, black soils occupy most of the parkbelt or parklands of Saskatchewan. Groves of trees and various shrubs often break the landscape, providing a sharp contrast to the broad expanse of the open prairie. This zone's improved moisture conditions are reflected in the dark soils and lush growth of native vegetation and cultivated crops. Lakes and sloughs are a common feature of the landscape. Cereal, oilseed, and hay crops are produced with livestock. Rapeseed is well adapted to the black soil zone's cooler climate.



Region 7, mixed, degraded black and grey soil associations have some of the features and characteristics of the prairie grassland and parkland. The landscape is characterized by successive knolls and depressions, glacial stones, and boulders. The vegetation is predominantly aspen and black poplar forest cover. Sloughs, bluffs, podzol depressions, and low knolls are typical of a large part of the area. Cereal crops, oilseeds, and livestock (mainly cattle and hogs) are produced throughout the region.

FARM SIZE AND LAND USE

During the last decade, the trend to larger farm operations increased significantly in the Prairie Provinces. The main factors contributing to this expansion were favorable grain prices, good to excellent crop yields, and improved government financing for land and equipment purchases. Moreover, the WGSA and various commodity price support programs provided greater income security and reduced risk. More recently, however, studies have indicated that the farm size expansion rate has decreased.

The land base for the sample farms remained nearly the same in 1977 and 1978. The average Saskatchewan acreage per farm consisted of 958 and 960 improved acres and 231 and 235 unimproved acres in the 2 sample years. Slightly more than one-third of the improved land was used for wheat, the principal cash crop. Barley was second in terms of acreage at 8 to 9 percent, followed by rapeseed or oats, flax, rye, and mustard.

In Regions 4 and 5, the open prairie area, there was a tendency to summer fallow one-half of the cash crop rotation. Between 42 and 49 percent of the land used for producing cash crops in these regions was in fallow. In Regions 6 and 7, the parklands area, there was a tendency to summer fallow only one-third of the cash cropland. On the average, 34 percent of the grain land in Region 6 was in fallow while in Region 7 it varied from 42 percent in 1977 to 36 percent in 1978.

There have been some changes in crop production. In 1978, Region 4 fallow acreage dropped and wheat acreage increased substantially from the 1977 figures. In Regions 5 and 7, wheat and rapeseed acreages increased at the expense of barley and oat acreages. In Region 6, cereal crop (wheat, barley, and oat) acreages decreased, accommodating a significant increase in rapeseed acreage.

In 1978, summer fallow acreages declined from 1977 levels by about 2.5 percent of the improved acreage. The decrease ranged from 1.0 percent in Region 5 to more than 4.0 percent in Region 7. The changes in crop production from one year to another may be significant with respect to price expectations, crop rotations, grain inventories, and quota allocations.

In Regions 6 and 7 a slightly larger proportion of the improved acreage was used for forage production. This was consistent with a more intensive livestock operation in the parklands than in the brown and dark brown soil zones (Tables 1 and 2).

FINANCIAL ANALYSIS

A comparative analysis of the 1977 and 1978 farm financial data showed large increases in the per acre cash receipts, cash expenses, inventories, and net incomes. Inflation was responsible for a substantial part of the increases but comparisons of input costs per acre also indicated appreciable increases in resource use in 1978 from 1977.

Livestock prices increased dramatically in 1978. This was reflected in livestock cash receipts and inventory values. In 1978 the livestock inventory values were considerably higher than in 1977, even though the numbers of cattle on farms were slightly less. To minimize unrealizable capital gains on the basic herds (bulls and cows), the 1978 values per head of these animals were held constant throughout the year at their esti-

TABLE 5. CASH RECEIPTS PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1977

Item	Saskatchewan (958)[a]	Region 4 (1077)	Region 5 (1123)	Region 6 (801)	Region 7 (812)
			dollars per acre		
Wheat	21.33	25.48	24.69	14.74	17.37
Barley	2.74	.38	2.91	5.90	2.53
Oats	.36	–	.23	.50	.78
Rye	–	–	–	–	–
Rapeseed	3.45	–	1.65	12.70	2.71
Flax	.59	–	.85	.65	.74
Mustard	.16	–	–	.43	.34
Other crop	.67	.63	.48	.97	.77
CWB payments	2.36	2.74	2.69	2.01	1.77
Stabilization	–	–	–	–	–
Crop and hail insurance	.49	.37	.72	.41	.35
Total crop receipts	32.15	29.60	34.22	38.31	27.36
Livestock receipts[b]	6.21	5.03	4.50	7.81	8.71
Other receipts[c]	2.28	1.97	2.45	2.15	2.43
Total cash receipts	40.64	36.60	41.17	48.27	38.50

[a]Figures in parentheses represent number of improved acres.
[b]Net of livestock purchases.
[c]Grants, subsidies, and miscellaneous receipts.

TABLE 6. CASH RECEIPTS PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1978

Item	Saskatchewan (960)[a]	Region 4 (1100)	Region 5 (1130)	Region 6 (793)	Region 7 (805)
			dollars per acre		
Wheat	21.76	24.34	24.61	13.20	21.30
Barley	3.55	.85	3.87	6.08	3.93
Oats	.35	–	.23	.38	.85
Rye	–	–	–	–	–
Rapeseed	4.39	–	2.61	14.12	4.23
Flax	.96	–	1.28	.98	1.45
Mustard	.20	–	.23	–	.50
Other crop	.65	.47	.26	1.65	.67
CWB payments	2.32	2.76	2.69	1.74	1.77
Stabilization	1.46	1.19	1.46	1.73	1.51
Crop and hail insurance	.60	.37	1.24	.46	–
Total crop receipts	36.24	29.98	38.48	40.34	36.21
Livestock receipts[b]	10.20	8.89	6.85	16.77	11.55
Other receipts[c]	1.99	1.96	1.82	1.60	2.58
Total cash receipts	48.43	40.83	47.15	58.71	50.34

[a]Figures in parentheses represent number of improved acres.
[b]Net of livestock purchases.
[c]Grants, subsidies, and miscellaneous receipts.

grain-livestock farms they increased 26 percent, from $41.36 an acre in 1977 to $52.17 an acre in 1978. Large farms, compared with their medium and small sized counterparts, placed greater emphasis on grain production relative to livestock and had a smaller increase in cash receipts.

Cash receipt increases were 13, 30, and 26 percent for large, medium, and small farms. By soil class category, cash receipt increases ranged from 22 percent on high assessment to 17 percent on low assessment farms (Tables 7 and 8).

In 1978, crop returns (including crop receipts and crop inventory increases) increased from 1977 figures by 20 percent in region 4, 6 percent in region 5, 8 percent in region 6, and 43 percent in region 7.

TABLE 7. CASH RECEIPTS PER ACRE BY FARM CLASS, CANFARM (WGSA) SAMPLE, 1977

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
	dollars per improved acre				
All farms	40.64	36.60	41.17	48.27	38.50
Grain farms	39.86	33.54	40.44	53.55	36.28
Grain-livestock	41.36	38.88	42.34	45.70	39.49
Large farms	41.51	38.82	40.86	50.89	37.54
Medium farms	38.34	33.22	39.38	41.98	39.50
Small farms	42.45	34.70	46.70	46.90	44.24
High assessment	45.84	47.96	38.22	71.53	43.93
Medium assessment	41.58	35.37	41.68	52.67	41.59
Low assessment	38.68	32.94	42.63	42.28	35.64

TABLE 8. CASH RECEIPTS PER ACRE BY FARM CLASS, CANFARM (WGSA) SAMPLE, 1978

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
	dollars per improved acre				
All farms	48.43	40.83	47.15	58.71	50.34
Grain farms	44.05	36.01	45.42	56.19	43.73
Grain-livestock	52.17	45.05	49.93	59.76	53.92
Large farms	46.93	40.86	43.51	56.94	49.91
Medium farms	49.83	40.24	49.06	59.41	51.52
Small farms	53.67	40.62	59.72	79.39	50.01
High assessment	55.94	54.36	50.45	72.60	61.71
Medium assessment	49.85	41.95	43.68	68.16	50.00
Low assessment	45.40	34.63	47.36	53.67	45.84

TABLE 9. CASH EXPENSES PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1977

Item	Saskatchewan (958)[a]	Region 4 (1077)	Region 5 (1123)	Region 6 (801)	Region 7 (812)
	dollars per acre				
Livestock feed and supplies	.50	.24	.64	.39	.61
Pesticides	1.03	.53	1.29	1.36	.93
Fertilizers	1.52	.33	1.47	3.44	1.35
Seed and crop supplies	1.31	1.63	1.08	1.27	1.36
Fuels and lubricants	2.96	2.45	2.48	3.80	3.54
Machinery repairs	3.02	2.65	2.67	3.35	3.66
Building repairs	.63	.75	.68	.37	.64
Tools and hardware	.14	.26	.23	–	–
Hired labor	1.21	1.09	1.51	1.22	.89
Custom work	.35	.21	.17	1.03	.28
Interest and finance	2.88	2.38	2.71	3.28	3.34
Insurance premiums	.87	.82	1.03	.52	.94
Electricity and telephone	.66	.56	.58	.76	.80
Land taxes	1.38	1.10	1.32	1.70	1.50
Rentals — land and other	.85	.39	.88	1.53	.76
Other expenses	3.75	3.31	3.57	4.90	3.60
Total cash expense[b]	23.06	18.70	22.31	28.93	24.20

[a] Figures in parentheses represent number of improved acres.
[b] Livestock purchases excluded.

There was a large variation in cash receipts between regions in both years. The differences between regions were not consistent from year to year. However, in both years, Region 4 had the lowest receipts per acre and Region 6 the highest. A weak positive correlation between assessment values of land and crop receipts per acre was observed, whereas a correlation between farm size and cash receipts per acre was not defined. However, the large regional differences in cash receipts and crop return averages imply that provincial averages of per acre returns do not in themselves constitute an equitable basis for farm policy formulation and program administration. For this reason the WGSA program incorporates cash receipts and cash expenses (net cash flow) in the formula for determining payouts to western grain producers.

Farm Cash Expenses

Farm cash expenses (excluding livestock purchases) rose 22 percent, from $23.06 an acre in 1977 to $28.13 an acre in 1978. Increases in expenses varied from 19 percent in Region 5 to 25 percent in Region 6.

Nearly all the 1978 expense items were higher than their 1977 counterparts. Pesticides, fertilizers, machinery operating costs, finance and interest charges, and rental charges were significantly higher in 1978 (Tables 9 and 10).

Cash expenses per acre increased 16 percent on grain farms, from $20.96 an acre in 1977 to $24.34 an acre in 1978. Grain-livestock farm cash expenses increased 27 percent, from $24.77 in 1977 to $31.36 in 1978. The large increases in cash expenses reflect higher expenditures in 1978 than in 1977 on fertilizers, pesticides, repairs to machinery and buildings, and all forms of energy. Although large farms had higher per acre cash expenses than the medium and small farms, the percentage increase from 1977 to 1978 was less at 20 percent on large farms than the 25 percent on medium and 24 percent on small farms.

The cash expense increases, by soil class category, ranged from 19 percent on high and low assessment farms to 29 percent on medium assessment farms. However, the relation between increases in expenses for each of these farm groups were not consistent when examined by region. High assessment farms had the largest percent increase in cash expenses in Regions 4 and 5 and the lowest percent increase in cash expenses in Regions 6 and 7 (Tables 11 and 12).

An analysis of crop cash expenses per cultivated acre showed an insignificant difference in the expenses of crop and grain-livestock farms.[4] Crop expenses per acre were significantly higher on small farms and on high assessment farms than on their counterpart large and low assessment farms. The indicated increase in crop cash expense for all farms in Saskatchewan was 19.5 percent, from $18.33 per cultivated acre in 1977 to $21.90 in 1978.

[4]From analysis of crop cash expenses per cultivated acre, CANFARM (WGSA) Sample, 1977 to 1978.

TABLE 10. CASH EXPENSES PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1978

Item	Saskatchewan (960)[a]	Region 4 (1100)	Region 5 (1130)	Region 6 (793)	Region 7 (805)
			dollars per acre		
Livestock feed and supplies	.64	.61	.62	1.29	.23
Pesticides	1.77	.75	1.89	2.85	1.80
Fertilizers	2.72	.69	2.81	4.87	3.04
Seed and crop supplies	1.43	1.63	1.04	1.83	1.48
Fuels and lubricants	3.51	2.69	3.04	4.51	4.32
Machinery repairs	3.55	3.07	3.18	4.25	4.05
Building repairs	.63	.48	.68	.48	.80
Tools and hardware	.23	.27	.35	–	.19
Hired labor	1.34	1.37	1.56	1.31	1.00
Custom work	.35	.38	.27	.54	.29
Interest and finance	3.69	3.54	3.01	4.83	3.99
Insurance premiums	1.00	1.24	.74	.96	1.17
Electricity and telephone	.82	.71	.71	1.02	.96
Land taxes	1.51	1.25	1.45	1.74	1.69
Rentals – land and other	1.03	.77	1.12	1.51	.80
Other expenses	3.91	3.63	4.05	4.28	3.71
Total cash expense[b]	28.13	23.08	26.52	36.27	29.52

[a]Figures in parentheses represent number of improved acres.
[b]Livestock purchases excluded.

TABLE 11. CASH EXPENSES BY FARM CLASS, CANFARM (WGSA) SAMPLE, 1977 (Excluding livestock purchases)

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
			dollars per improved acre		
All farms	23.06	18.70	22.31	28.92	24.20
Grain farms	20.96	14.51	21.08	30.32	22.15
Grain-livestock	24.77	21.85	24.24	28.25	25.13
Large farms	23.68	20.06	23.39	28.89	23.17
Medium farms	21.80	17.36	20.08	27.87	24.54
Small farms	23.08	16.09	22.58	34.42	34.06
High assessment	27.65	27.59	21.55	44.79[a]	30.94
Medium assessment	22.48	18.13	22.07	29.31	23.68
Low assessment	21.89	15.62	22.83	25.75	22.87

[a]Includes land rent of more than $50 000 on one farm.

TABLE 12. CASH EXPENSES BY FARM CLASS, CANFARM (WGSA) SAMPLE, 1978 (Excluding livestock purchases)

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
			dollars per acre		
All farms	28.13	23.08	26.52	36.27	29.52
Grain farms	24.34	17.75	24.64	34.19	29.26
Grain-livestock	31.36	27.77	29.53	37.15	31.27
Large farms	28.34	24.05	27.21	35.00	29.01
Medium farms	27.35	20.18	24.30	37.36	29.51
Small farms	28.63	23.12	27.26	47.73	35.31
High assessment	32.88	37.25	27.88	37.86[a]	35.51
Medium assessment	29.07	20.73	26.03	45.79	29.11
Low assessment	26.15	19.09	26.20	32.58	27.27

[a]Reflects large reduction in cash rent on one farm.

TABLE 13. FINANCIAL STATEMENT PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1977

Item	Saskatchewan (958)	Region 4 (1077)	Region 5 (1123)	Region 6 (801)	Region 7 (812)
			dollars per acre		
Total receipts	40.64	36.60	41.17	48.27	38.50
Total expenses	23.06	18.70	22.31	28.93	24.20
Net receipts	17.58	17.90	18.86	19.34	14.30
Plus ending inventory					
Crops	34.33	28.42	35.56	36.38	32.74
Livestock	9.30	9.83	4.34	13.18	13.08
Supplies	.36	.22	.55	.35	.20
Minus beginning inventory					
Crops	29.55	29.23	32.65	29.76	25.42
Livestock	8.81	9.56	4.71	11.55	11.99
Supplies	.53	.44	.64	.73	.32
Net before depreciation	22.67	17.14	24.31	27.21	22.59
Depreciation	7.47	7.70	5.57	8.37	9.36
Net farm income	15.20	9.44	18.74	18.84	13.23

[a]Figures in parentheses represent improved acres.

TABLE 14. FINANCIAL STATEMENT PER IMPROVED ACRE, CANFARM (WGSA) SAMPLE, 1978

Item	Saskatchewan (960)[a]	Region 4 (1100)	Region 5 (1130)	Region 6 (793)	Region 7 (805)
			dollars per acre		
Total receipts	48.43	40.83	47.15	58.71	50.34
Total expenses	28.13	23.08	26.52	36.27	29.52
Net receipts	20.30	17.75	20.63	22.44	20.82
Plus ending inventory					
Crops	40.50	32.14	41.15	42.54	46.47
Livestock[b]	12.31	12.58	6.04	17.89	17.02
Supplies	.15	.19	.05	.22	.19
Minus beginning inventory					
Crops	33.39	27.69	37.22	34.20	32.92
Livestock	9.30	9.83	4.34	13.18	13.08
Supplies	.35	.21	.53	.34	.22
Net before depreciation	30.22	24.93	25.78	35.37	38.28
Depreciation	7.95	7.62	5.58	9.38	10.72
Net farm income	22.27	17.31	20.20	25.99	27.56

[a] Figures in parentheses represent improved acres.
[b] Values adjusted for basic herd (bulls and cows) to eliminate unrealized capital gains.

Net Farm Income

After allowing for depreciation, and adjusting for inventory changes in crops, livestock, and supplies, the indicated return per cultivated acre was $15.20 in 1977 and $22.27 in 1978, an average increase of nearly 47 percent an acre for all farms. Net farm income per cultivated acre rose from $9.44 to $17.31 (83 percent) in Region 4, from $18.74 to $20.20 (8 percent) in Region 5, from $18.84 to $25.99 (38 percent) in Region 6, and from $13.23 to $27.56 (108 percent) in Region 7. There was a reduction of summer fallow acreage per farm in 1978. This probably contributed to the relatively large increases in the crop inventory values in all regions. Region 5, with the least concentration of livestock per farm, had the smallest increase in net farm income (Tables 13 and 14).

In 1977, grain farms had higher net farm incomes per acre than grain-livestock farms, but in 1978 the situation was substantially reversed. Much higher cattle prices in 1978 were largely responsible for this reversal. Large farms, emphasizing grain production to a greater degree than small and medium farms, had higher net farm incomes in 1977 than did the medium and small farms. In 1978, however, large farms had the smallest and small farms had the largest net farm incomes per acre. On the average, high assessment farms had the largest net farm incomes per acre in both years of all Saskatchewan farms (Tables 15 and 16).

SUMMARY

A comparative study of the 1977 and 1978 farm data from a CANFARM probability sample of Saskatchewan farms indicated a small increase in farm size. Average per farm cultivated acres increased from 958 to 960 and total land area rose from 1189 acres in 1977 to 1195 acres in 1978.

TABLE 15. NET FARM INCOME, CANFARM (WGSA) SAMPLE, 1977

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
			dollars per improved acre		
All farms	15.20	9.44	18.74	18.84	13.23
Grain farms	18.66	13.81	21.98	18.75	15.96
Grain-livestock	12.44	6.15	13.71	18.88	11.96
Large farms	15.65	8.55	19.22	21.13	13.02
Medium farms	14.58	11.32	18.14	12.72	14.40
Small farms	14.35	9.08	18.21	20.59	9.93
High assessment	19.94	12.27	27.12	20.10	13.55
Medium assessment	15.89	12.82	20.87	25.28	13.01
Low assessment	12.59	6.25	13.89	16.34	13.27

TABLE 16. NET FARM INCOME, CANFARM (WGSA) SAMPLE, 1978

Farm Group	Saskatchewan	Region 4	Region 5	Region 6	Region 7
	dollars per improved acre				
All farms	22.27	17.31	20.20	25.99	27.56
Grain farms	19.95	16.38	19.72	19.56	25.66
Grain-livestock	24.25	18.14	20.96	28.63	28.62
Large farms	21.40	15.93	18.89	25.37	26.95
Medium farms	23.57	18.04	22.70	25.08	28.40
Small farms	24.25	21.17	21.65	39.55	31.17
High assessment	25.76	18.55	24.91	34.93	31.39
Medium assessment	23.09	19.41	18.02	27.78	30.18
Low assessment	19.90	15.33	17.09	24.31	24.37

A shift to more wheat and rapeseed acreage occurred in 1978, with less acreage in barley and oats. There was also an increase in the seeded acreage in all regions, mostly due to reduced summer fallow acreages.

The financial analysis showed substantial increases in owner equities, receipts, expenses, and net farm income. A large part of the increase was due to inflationary price trends but there was an indicated increase in physical crop production and resource base. In particular, livestock prices and values increased dramatically in 1978. This reflected the large increases in livestock receipts and livestock inventory values from 1977 figures, even though livestock numbers on farms were still declining.

On the average, farm asset value increased more than 16 percent, from \$130.55 to \$152.26 a cultivated acre. Owner equity rose 18 percent, from \$93.72 in 1977 to \$110.78 an acre in 1978. Region 6 and Region 7 (parkland black and degraded black soil zones) contributed the most to the average equity increase. Owner equity increases ranged from 11 percent in Region 4 to 30 percent in Region 7.

Total liabilities for all farms rose modestly from \$36.83 an acre in 1977 to \$41.48 in 1978 for all farms. The largest increase in liabilities occurred in Region 7, rising 20 percent from \$47.38 an acre in 1977 to \$56.92 in 1978.

Farm cash receipts rose 19 percent, from \$40.64 an acre in 1977 to \$48.43 in 1978. A large part of the increase was due to much higher livestock (cattle) prices in 1978 than were obtained in 1977. On the average, crop receipts[5] per acre rose 13 percent but livestock receipts increased 64 percent in 1978 from 1977 levels for all farms. Grain-livestock farms had larger increases in cash receipts than grain farms in all regions; and in both years, on the average, they had higher receipts per acre. However, in 1978 the differences were more pronounced.

In 1977, large farms had higher cash receipts per acre than medium size farms and slightly lower receipts per acre than small size farms; but in 1978, small farms had the highest and large farms had the lowest cash receipts per acre. In both years, cash receipts per acre were generally larger on high assessment farms and smaller on low assessment farms.

Crop returns (including crop receipts and crop inventory increases) were on the average 17 percent higher for all farms in 1978 than in 1977. Regions 4 and 7 contributed most to the increase in crop returns by substantially reducing their summer fallow acreage and increasing their seeded crop acreage.

Excluding livestock purchases, average cash expenses per acre were 22 percent higher in 1978 than in 1977 for all farms. Grain farms had a smaller increase in cash expenses per acre than grain-livestock farms, and large farms had a smaller percentage increase in expenses than medium and small farms. There was, however, considerable variation in the percentage increases in expenses between regions.

The combined operating and depreciation costs per acre for all farms were \$30.55 in 1977 and \$36.08 in 1978, an increase of 18 percent. After adjustments for inventory changes the average net farm incomes per acre for all farms were \$15.20 in 1977 and \$22.27 in 1978.

[5] Including crop sales, CWB payments, stabilization receipts, crop, and hail insurance receipts.

Economic indicators

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1979 II	1979 III	1979 IV	1979 Annual	1980 I	1980 II	1980 III	1980 IV	1980 Annual	1981 I
Production and income											
1. GNP at market prices[a]	$ mil.	257 448[b]	266 624[b]	275 260[b]	261 961[b]	280 224[b]	284 368[b]	291 052[b]	303 792[b]	289 859[b]	314 956
2. Farm cash receipts, total[d]	$ mil.	3 301.3[b]	3 459.0[b]	4 095.7[b]	14 251.2[b]	3 798.8	3 460.0	3 948.6	4 430.2	15 637.6	4 939.7
3. – total crops[d]	$ mil.	1 212.6	1 479.6[b]	1 974.7[b]	6 121.5[b]	1 339.0	1 360.6	1 738.7	1 966.6	6 899.7	2 780.5
4. – total livestock[d]	$ mil.	1 950.9[b]	1 886.3[b]	2 031.8[b]	7 733.3[b]	1 900.7	1 974.6	2 118.1	2 324.3	8 317.7	2 073.5
5. Net income rec'd by farm operators[a]	$ mil.	4 180.0[b]	2 868.0[b]	3 936.0[b]	3 690.[b]	3 184.0[b]	2 788.0[b]	3 436.0[b]	3 263.0[b]	3 263.0[b]	4 448.0[b]
Trade											
6. Agricultural exports	$ mil.	1 354.7	1 663.9	1 884.8	6 107.8	1 501.5	2 008.2	2 003.5	2 331.4	7 844.6	1 906.6
7. Agricultural imports	$ mil.	1 181.6	1 129.4	1 240.4	4 680.6	1 158.9	1 256.9	1 173.6	1 517.8	5 107.2	1 406.5
8. Real domestic product, ag[a]	1971 = 100	104.9	105.5	112.4	108.1	110.4	109.6	107.7	109.4	109.3	114.8
9. Real dom. prod., less ag[a]	1971 = 100	138.9	140.8	140.4	139.7[b]	139.5	138.7	139.5	141.6	139.9	143.4
Price indexes											
10. Farm input price index	1971 = 100	234.4	236.1	239.6	234.9	253.2	250.3	258.6	267.5	257.4	280.8
11. – buildings and fencing	1971 = 100	233.2	229.5	235.3	226.0	235.5	236.4	242.2	242.7	239.2	247.3
12. – machinery & motor veh.	1971 = 100	191.8	196.2	205.3	193.3	214.2	221.7	227.0	237.4	225.1	248.0
13. – crop production	1971 = 100	252.5	258.5	266.5	254.0	296.9	309.1	304.9	310.7	305.4	329.2
14. – animal production	1971 = 100	252.3	249.2	247.8	249.0	252.7	232.8	256.2	266.8	252.1	269.9
15. – hired farm labor	1971 = 100	232.8	235.7	237.8	233.6	242.1	245.1	249.2	253.1	247.4	257.7
16. – interest	1971 = 100	395.3	395.3	395.3	395.3	466.7	460.9	448.7	473.1	462.4	553.7
17. Farm prices of ag. prod.[d]	1971 = 100	250.7[f]	247.7[f]	246.4[f]	298.8[f]	262.1[f]	255.9[f]	272.3[f]	290.7[f]	270.2[f]	287.9
Input and credit											
18. Farm impl. & equip. sales[e]	$ mil.	N.A.	N.A.	N.A.	1 701.0	N.A.	N.A.	N.A.	N.A.	1 745.0	N.A.
19. Employment in agriculture[a]	'000	489.3	475.7	481.0	483.8	490.0	478.0	466.0	478.0	478.0	477.0
20. Av. farm labor rates	$/h	3.95	4.01	4.08	3.98	4.15	4.22	4.24	4.31	4.23	437.0
21. Av. hourly earnings-manuf.	$/h	7.37	7.50	7.68	7.44	7.89	8.04	8.28	8.53	8.19	8.78
22. F.C.C. – gross loan disburs.	$ mil.	174.7	192.4	145.2	547.7	98.5	189.6	139.3	95.8	427.4	74.0
23. CPI – all items	1971 = 100	189.4	193.1	197.6	191.2	202.0	207.6	213.5	219.5	210.6	226.6
24. – food at home	1971 = 100	237.9	241.6	243.8	238.0	250.3	258.2	270.3	279.4	264.5	288.5
25. – food away from home	1971 = 100	220.8	227.3	232.4	223.4	237.1	240.7	246.6	251.8	244.1	257.3
26. Industry selling price index – food & beverage	1971 = 100	230.1	233.3	237.5	231.7	244.2	247.9	260.5[b]	273.8[b]	256.6[b]	275.5

continue

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1979				1980					1981
		II	III	IV	Annual	I	II	III	IV	Annual	I
Other indicators											
27. Unemployment rate	%	7.6	7.1	7.3	7.5	7.5	7.7	7.5	7.4	7.5	7.3
28. Exchange rate	$ U.S.	1.16	1.17	1.19	1.17	1.16	1.17	1.16	1.18	1.17	1.19
29. Chartered banks' rate on prime business loans	%	12.00[b]	12.67[b]	14.96[b]	12.91[b]	15.25[b]	14.58[b]	12.29[b]	14.92[b]	14.26[b]	18.08
30. Quarterly pop. est.	mil.	23.64	23.70	23.75	23.67	23.81	23.87	23.94	24.01	23.91	24.09

[a]Seasonally adjusted at annual rates.
[b]Revised.
[c]Preliminary.
[d]Excludes Newfoundland.
[e]Excluding repair parts.
[f]Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Marketing & Economics Branch; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

Notes

AGRI-FOOD STRATEGY DISCUSSION PAPER

Agriculture Minister Eugene Whelan released in July an agri-food strategy discussion paper which will form the basis for establishing national agriculture and food priorities for the 1980s.

Canada could increase its food production by two-thirds before the year 2000. Rising world population and rising income in many developing countries will ensure that there is a strong demand for that higher level of production. To achieve our food-producing potential, strong public and private sector cooperation in removing the constraints to growth is necessary.

The discussion paper outlines how those constraints can be overcome, through action in three main areas:

– market development;

– strengthening the supply base; and

– mission-oriented agricultural research.

Agriculture Canada has received Cabinet approval to discuss this development perspective with provincial governments and the private sector. The minister is confident that with their ideas and participation in addressing the priority items outlined in the discussion paper, the following national goals can be met:

– annual farm cash receipts could go to $35 billion, in today's dollars, by the year 2000, from the current level of $15 billion;

– thousands of new jobs could be created in the agriculture, processing, distributing, and supply sectors;

– Canada's balance of payments could be strengthened, since most of the additional production would go into exports;

– Canadians would be assured of a continuous food supply; and

– each province and region would have development opportunities in boosting production of commodities and processed foods for which it has a natural comparative advantage.

The agri-food strategy would also help Canada meet its obligations to the international community through increased food trade and agriculture development assistance.

Copies of the Agri-Food Strategy Discussion Paper are available from Agriculture Canada's directors of food and agriculture development in each province or from the department's Information Services in Ottawa. Comments on the strategy can be addressed to the Minister of Agriculture in Ottawa or through the department's directors of food and agriculture development in the provinces.

ADDITIONAL FUNDS FOR ENERGY RESEARCH IN AGRICULTURE

Agriculture Canada will spend $2.8 million on contracts for energy research and development in this fiscal year.

This is another step in Agriculture Canada's commitment to develop new energy technology for the agri-food sector.

About $1.8 million of the funds is Agriculture Canada's share of the recently-announced government-wide $35 million increase in energy research funds being made available under the National Energy Program. The $1.8 million will be added to existing funds for research contracts in the private sector. These contracts will total $2.8 million in 1981-82, compared with $3.3 million spent for such projects during the last 7 years.

Agriculture Canada's Engineering and Statistical Research Institute in Ottawa will coordinate the contracts. Proposals are being invited through Supply and Services Canada advertising.

With funds re-allocated from departmental resources, 12 energy engineers have been hired in the last year to set up energy R & D centers in research stations in Kentville, N.S.; St.Jean, Que.; Harrow, Ont.; and Swift Current, Sask.; and in the Engineering and Statistical Research Institute in Ottawa.

The first priority is energy conservation and the substitution of cheaper energy sources for oil. Also, substantial funds have been allocated to develop technology for energy production in the agri-food industry.

As new technology makes energy production economical, farmers could achieve a degree of energy self-sufficiency.

Research will cover energy use in all parts of the food supply chain from the farmer to consumer. Main areas of research will include:

– conservation in greenhouses, farm buildings, field operations, and fertilizer use;

– conservation in food processing through more efficient water removal, freezing, and thermal processes;

– production and use of liquid fuels, such as fuel alcohol and canola oils; and

– energy production from renewable sources, including solar, wind, biomass, and energy crops.

In addition to research, the department will examine the economic effect of energy on the agri-food system and the effect of government regulations and market price changes associated with energy.

Agriculture Canada is working closely with Energy Mines and Resources and other federal departments. Under the National Energy Program, it has been agreed that agricultural production and processing of perishable foods will be given top priority for energy supplies in the event of an emergency.

The expanded R & D program and other activity reflects Agriculture Canada's long-term commitment to develop new technology for farmers and processors to help them meet the challenges of the 1980s and beyond.

This is consistent with the department's recently released strategy for developing Canada's agricultural potential by the year 2000. Energy is one of the roadblocks to achieving that potential and energy research and development is a key component in the strategy discussion paper.

AGRICULTURAL OUTLOOK CONFERENCE

This year's Agricultural Outlook Conference will be held at the Government Conference Centre in Ottawa, December 7 and 8.

The conference brings together heads of the federal and provincial departments of agriculture, and representatives from farm organizations, universities, consumer groups, agribusiness, and other government departments to discuss agricultural prospects for the coming year.

Speakers will discuss general economic trends, the world agricultural and food outlook, Canadian agricultural and food market prospects in 1982, expected farm costs and incomes, and other issues important to the agriculture and food sector.

In addition to the presentation of outlook papers, there will be individual sessions dealing with cattle and hogs, grains and oilseeds, horticultural products, poultry and eggs, dairy products, and farm costs and incomes.

A special session of the conference this year will focus on the national agri-food strategy and on long-term market prospects.

The conference is open to all interested persons and organizations. For further information contact:

Conference Secretary
Canadadian Agricultural Outlook Conference
Marketing and Economics Branch
Agriculture Canada
Room 339, Sir John Carling Building
Ottawa, Ontario
K1A 0C5
(613) 995-9554

FARMBANK

FARMBANK is a computerized commodity data base maintained by Agriculture Canada's Marketing and Economics Branch. It contains approximately 1000 regional, national, and international food and agriculture data series for prices, production, stocks, consumption, imports, exports for all major grains and livestock products, as well as farm income statistics, retail prices, and general economic data.

FARMBANK data are mainly quarterly, and originate as far back as 1950. They are collected from Agriculture Canada and other Canadian, U.S., and international sources.

FARMBANK is now available on-line for a monthly fee from the Conference Board of Canada and Datacrown Inc. Prospective clients may contact their marketing representatives for more information about the data base and how to access this information.

The marketing representative for the Conference Board of Canada is Mrs. Viviane Paré; their address is 25 McArthur Ave., Vanier, Ontario, K1L 6R3. Datacrown Inc.'s representative is Mr. Jim Dunn and their mailing address in 770 Brookfield Road, Ottawa, Ontario, K1V 6J5.

Publications

Farm Management Information Catalogue. *Available free from Agriculture Canada's Farm Development Division, Ottawa, Ont., K1A 0C5.*

Agriculture Canada's Farm Management Information Catalogue is a central reference directory of management materials for Canadian farmers. The quarterly catalogue, begun in July 1980, provides a list of government, university, and private agency publications and periodicals to keep farm management specialists up to date on the latest research and practical information.

Farmers are seeking more and more information about business practices they can apply to their own operations. The catalogue makes it easier for farm management specialists and extension people to find the information to answer farmers' questions.

The first four editions of the catalogue have listed about 2000 entries from more than 30 Canadian and U.S. agricultural information sources. The catalogue now reaches more than 400 subscribers across Canada and is available in both English and French.

The publication provides listings under such topics as financial management, taxes, accounting, production economics, and farm law. The most recent issue focused on farm finances, and the coming issue will highlight information on farm computers.

The catalogue is also planned as a forum to announce management seminars and other activities for agricultural professionals. Research on particular farm business management problems may also be listed.

A reply sheet is provided with the catalogue so readers may offer suggestions for future listings and special-interest features.

Plans are also under way to make the information available to individuals and organizations on computer tape.

The Canadian Agri-Food System. September 1981; 57 pp. *Available free from Information Services, Agriculture Canada, Ottawa, Ont., K1A 0C7.*

This publication provides a descriptive and statistical review of the Canadian agri-food system, from the farm to the consumer. The review ranges from the inputs required by farmers to the marketing, processing, distributing, and retailing of food products. The review also covers non-food products in the system, such as tobacco and leather.

The review describes Canada's agricultural land base, and indicates changes in the number of farmers, the value of farm capital and the rising capital requirement of farmers.

Agricultural input and service industries covered are: credit, farm machinery, fertilizers, pesticides, energy, and agricultural research.

A section deals with agricultural marketing and processing industries, based on wheat, coarse grain, oilseed, beef, dairy, poultry, and horticulture commodities.

Another section deals with the food retailing and the consumer parts of the agri-food system, outlining the structure of the food and beverage processing industry and the marketing, distribution, and retailing of food, including restaurants and other food service institutions. Also included is an analysis of the food consumption and expenditure patterns of Canadians.

A final section deals with Canada's agricultural trade. Canada is one of only four net food exporting countries in the world today. Last year, agricultural exports reached $7.9 billion in value, while imports were $5.1 billion. The publication provides a breakdown of food exports by country of destination and food imports by country of origin.

The publication was produced by Agriculture Canada in response to a growing public need for knowledge about the agri-food system.

The following publications are available free from the Publications Manager, Regional Development and International Affairs Branch, Agriculture Canada, Ottawa, Ont., K1A 0C5.

Agriculture Abroad – A bi-monthly digest of agricultural policies and programs in various countries. Vol. 36, No. 3, June 1981, 37 pp.

Food Market Commentary. Vol. 3, No. 2, June 1981, 35 pp.

List of Materials Published in 1979-1980 by Members of the Marketing and Economics Branch and Regional Development and International Affairs Branch. July 1981, 9 pp.

Market Commentary – Animals and Animal Products. July 1981, 49 pp.

Market Commentary – Grains and Oilseeds. July 1981, 50 pp.

Market Commentary – Milk and Dairy Products. July 1981, 29 pp.

Working Paper: Proceedings of the Agriculture Session – Canadian Problems in a Global Perspective, A Dialogue between Canada and the International Institute for Applied Systems Analysis (IIASA), held in Ottawa, October 1-2, 1980. August 1981, 137 pp.

IN REPLY TO AUTHORS AND EDITORS REGARDING VOL. 16, NO. 4, 1981

CANADIAN FARM ECONOMICS

I have read	*and on a scale of 0 to 10, found it* *not useful*		*very useful*
K.D. Russell, R. Hironaka, and D.B. Wilson	0	5	10
W. Darcovich	0	5	10
M.M. Sorboe	0	5	10
Economic indicators	0	5	10
Notes	0	5	10
Publications	0	5	10

Comments on (name of section of article) ____________________

Do you have any other suggestions or questions on the contents of this issue?

My comments may ( ) may not ( ) be used in a future issue of this publication. (A copy of your comments will be forwarded to the author.)

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E.A. Love, Managing Editor, Canadian Farm Economics
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Agriculture Canada, Sir John Carling Building
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Canadian farm economics

VOLUME 16
NUMBER 5
OCTOBER 1981

1 A scheme for defining drought areas *J.A. Dyer, D.G. Warner, and R.B. Stewart*

9 Economic analysis of rapeseed meal and fishmeal as protein supplements in chicken broiler diets *S. Al Hassan, K.B. McRae, H.W. Hulan, and F.G. Proudfoot*

16 Proposal for a target level of frozen chicken storage stocks *P. Blakely*

21 Economic indicators

23 Notes

25 Publications

29 In reply

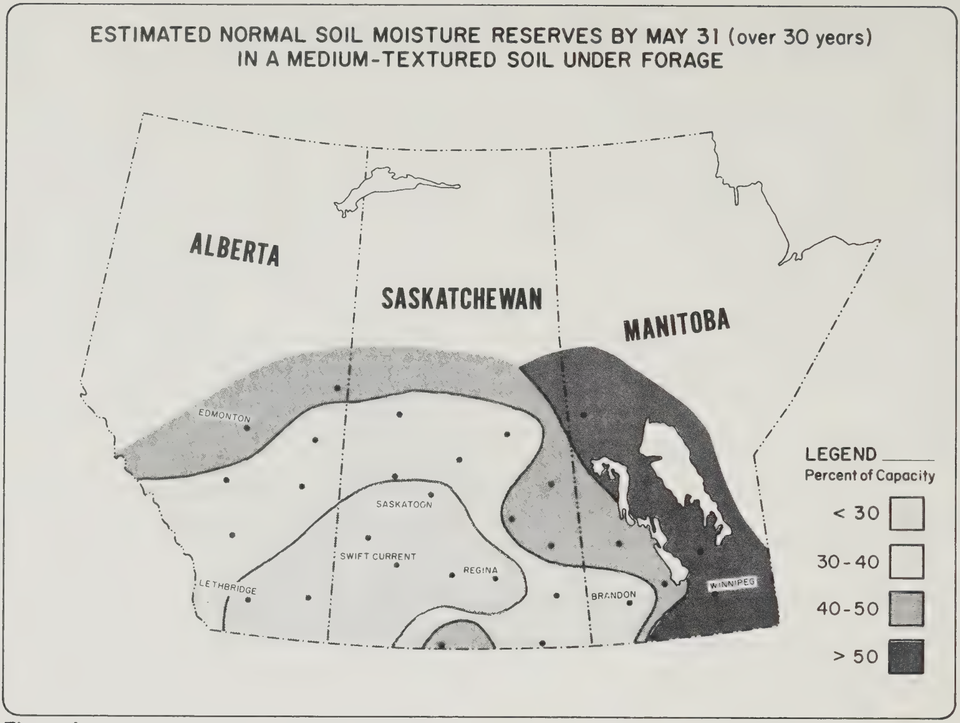


Figure 1

conditions, including rainfall and evaporation rates, and is too complex to be described by precipitation records alone. 2. Since this scheme is for livestock producers, drought is defined only on the basis of those factors which limit forage growth. Therefore, an analysis designed specifically for forages, rather than grain crops, is needed. 3. The criteria should not support poor management. Therefore, only the environmental impacts on forage growth that are related to drought are considered. These impacts are determined by using weather and soil factors incorporated into a computer simulated model to produce soil moisture estimates. 4. Certain soils, particularly in sandy areas, are more often affected by drought than others because of their reduced capacity to store water available to the plant. 5. Compounding this problem is the fact that certain areas are also more drought prone because of their regional climate. (Figure 1 shows the average moisture reserves for a uniform capacity soil by May 31 on the Prairies.)

MATERIALS AND METHODS

To incorporate these concepts into a system for defining drought, both soil and weather data and a variety of analytic techniques were used. Computer simulations of current and long-term weather conditons were required.

Simulation Model

The versatile soil moisture budget (Baier and Robertson, 1966) was used to determine soil moisture reserves for an assumed hypothetical water-holding capacity. (Water-holding capacity is the maximum water storage in the root zone which is available for plant use.) The differences in assumed capacities help account for the role of soil, as well as weather, in decreasing early season forage growth. This computer budgeting technique is essential to this system because it considers the environmental parameters most important to drought and stress on plants due to water shortage. These include rain distribution during the growing season, as it affects runoff, drainage, and storage; the distribution of water in the soil and changing root density with depth; the daily evapotranspiration rates; and the contribution to soil moisture reserves in the spring from melted snow.

The foregoing factors are used in a daily water-balancing technique applied to a number of soil layers by computing water exchanges between adjacent layers and with plants and the atmosphere. This model is also being used in a Soil Moisture Evaluation Project (SMEP) for the Prairie Provinces (Edey, 1980). Weekly reports, including maps of soil moisture reserves for three possible water-holding capacities based on current weather records, are generated in the SMEP throughout the

growing season. Current year estimates of soil moisture reserves are also used in this study. The use of the moisture budget here differs from its use in the SMEP because the root extraction coefficients are based on a generalized forage rather than a generalized grain crop. From estimates of soil moisture reserves at some weather-recording sites, maps similar to that in Figure I were prepared for each of four soil types.

Weather Records

Two types of daily weather record are required in this scheme. Daily rainfall records are available from more than 700 stations in the Prairies. These provide spatial resolution, but they are not all taken with sufficient regularity to be used in the simulation models. Stations which have adequate reporting regularity, quality, and records for past years are much more limited. In this study, computer simulation of soil moisture reserves by May 31 were made at 30 weather stations. Both historical and current weather records were analyzed, so that current drought situations could be compared with long-term averages. May 31 was selected because it represents the time when early season pasture and hay growth are most crucial to beef-herd maintenance.

Soil Maps

Soil type information is available from the soil surveys conducted throughout the Prairies. From these a map of soil textures has been prepared which delineates areas of sand, loam, clay loam, and clay.[1] These have been classified according to a broad range of water-holding capacities.

MAP OVERLAYING PROCEDURE

In the first phase of the scheme's development, all relevant information required to delineate drought areas was assembled by overlaying various resource maps on a base map showing the township boundaries.

The first map to be overlaid is a soil texture and water-holding-capacity map. From this, each township was assigned a representative soil texture based on the dominant soil class contained in each.

The second type of overlay uses soil-moisture-content maps generated for May 31 of the current year. Before these could be overlaid, it was necessary to simplify the moisture reserve maps. Only one isoline of uniform soil moisture reserves to enclose areas having reserves below a selected threshold level was drawn for each water-holding-capacity class. Four of these maps were incorporated, each representing a specific moisture-holding capacity (that is, 100 mm, 150 mm, 200 mm, and 250 mm of water in a 100-cm root zone). These four capacity values, corresponding roughly to sand, loam, clay loam, and clay, are defined here as very light, light, medium, and heavy soils. This scheme differs from the SMEP which considered moisture-holding capacities of 280, 200, and 150 mm.

The lighter soils are more drought prone because of their lower moisture capacities. Soil moisture estimates, such as contained in the SMEP maps, are expressed in terms of percentages of normal soil moisture reserves. The normal represents the average estimate during a 30-year period. Normalizing minimizes the soil type differences. Howerver, normals in light soils are dramatically affected by extremely wet years, so more than half the years are below average.

Overlaying precipitation maps, representing several months accumulation, will allow the initial drawing or correcting of the soil moisture isolines to be done with increased confidence because of the greater number of stations used to prepare precipitation maps. This final step in the overlay procedure is essential if the isolines are to be precise enough to accurately represent townships.

CRITERIA FOR DROUGHT

Our criteria specify that all townships fully or partly enclosed by areas with estimated soil moisture levels below selected threshold levels are suffering from drought. The contour lines of estimates equal to the threshold values are selected as the soil-moisture-criteria isolines. Each isoline of threshold-soil-moisture levels on each soil class is used to define drought on the corresponding texture class of soil.

The selection of soil moisture values for which the isolines are to be drawn must give equitable treatment to producers on different soil types. These selections are critical to the successful application of this scheme. They can be made somewhat subjectively, by trial and error, where test maps are drawn to show approximate areas of defined drought on each soil type. Users of the scheme would consider the extent of the area to be designated as drought on each soil type in any particular year.

If, in the long term, the selection of isoline criteria is to be consistent, more objective means of choosing threshold values are required. To increase the objectivity, estimates of probabilities of recurrence of threshold-soil-moisture values would help decision makers interpret the long-term implications of criteria selection, and estimates of forage growth based on expected soil moisture reserves would help to ensure equitable treatment to farmers in different soil and climate areas.

[1] The authors are indebted to Jack Shields of the Land Resource Research Institute, Research Branch, Agriculture Canada, for providing the source material and helping with the preparation of this map.

Thresholds can be chosen which result in the same estimates of forage growth for the different soil textures. Relative forage growth estimates for the same periods of weather records on each soil class can be generated with a forage growth model currently being used to settle corp insurance claims (Selirio and Brown, 1978). The required soil moisture term in this model can be provided by the Versatile Soil Moisture Budget estimates used here (Baier *et al.* 1979). A procedure for objectively selecting these threshold levels, using forage growth rates and long-term probabilities, has been developed and will be described in a follow-up paper.

SAMPLE FORAGE ASSISTANCE SCHEME

The following shows how the proposed scheme can be used to delineate a drought area and its usefulness in administering drought assistance programs. Figure 2 illustrates several hypothetical situations, or claim scenarios, with which administrators could be faced. First, it will be helpful to consider the assumptions used in the development of Figure 2:

1. The land included represents an agricultural area of 12 townships by 12 townships (72 x 72 mi or 115 x 115 km).
2. Each township has been arbitrarily assigned a number from 1 to 4, representing four different soil textures or water-holding capacities. Only the most dominant soil texture within the particular township is considered in this test. The numbers are assigned in such a way as to simulate the type of soil texture patterns administrators might expect to see when settling claims in areas nearest to the isolines. The soil texture number codes 1 to 4 refer to the soil texture classes defined as very light (100 mm), light (150 mm), medium (200 mm), and heavy (250 mm).
3. Four separate isolines are illustrated in Figure 2. These isolines represent computer estimates of the soil moisture for each texture class which are at the respective threshold moisture reserve level. Areas below each illustrated section of isoline are considered to be enclosed by that isoline and have moisture reserves below the respective threshold level. The actual selection of the soil moisture isolines and their long-term implications are described elsewhere. Each isoline applies only to the townships that have been assigned the corresponding soil texture class.
4. All farmers in townships which are cut by or included inside the isoline corresponding to the assigned soil texture in that particular township would be eligible for assistance. Correspondence is based on the approximate moisture capacity of the soil, compared with the capacity used in the computer simulated isoline. Following are eight possible claim scenarios with various possible assistance outcomes depending upon the location of the farmers in relation to the respective isolines. (See Figure 2 for the outcomes for all 144 theoretical townships.)

Farmer A – Eligible for assistance since the dominant soil texture (1) corresponds to the 100-mm soil moisture isoline I-1 cutting through this township.

Farmer B – Ineligible for assistance since the 100-mm isoline I-1 which cuts through this township corresponds to a soil texture which has a much lower capacity than the number 3 (clay loam) assigned to this township.

Farmer C – Ineligible for assistance even though the township is cut by I-1. This isoline does not correspond to soil texture 2. To qualify, this township must be cut or enclosed by I-2.

Farmer D – Ineligible for assistance since this township has a designated soil texture of 3 while being included only by I-1.

Farmer E – Eligible for assistance since the dominant soil texture 2 corresponds to and is enclosed by I-2.

Farmer F – Eligible for assistance since the township which includes his farm is cut by I-3 (200-mm capacity) which corresponds to soil texture 3.

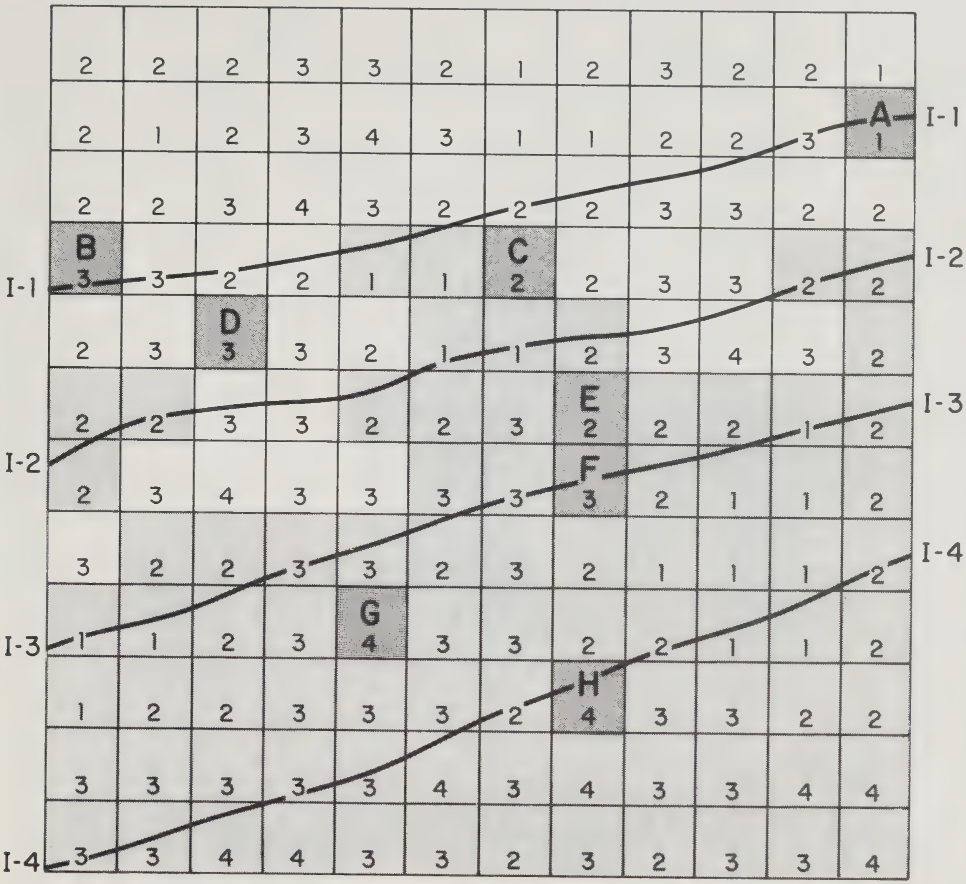
Farmer G – Ineligible for assistance since soil texture 4 does not correspond to I-3.

Farmer H – Eligible for assistance since the township which includes his farm is cut by I-4 which corresponds with soil texture 4.

Farmers B, C, D, and G in Figure 2 were considered ineligible for assistance because their farms were located in townships not qualifying for assistance using soil moisture reserves and precipitation criteria. Soil textural boundaries do not of course follow township boundaries. There are also transition zones from one soil type to another, to which the 1:2 million scale soil maps are not always sensitive. It is inevitable, therefore, that within small areas there will be some farms more seriously affected than others. The scheme proposed here can be adopted to accomodate such differences.

1. More detailed soil texture maps can establish which soil texture or textures (1, 2, 3, or 4) would be found on a particular farm and if that farm is different from the township's assigned texture. Soils and crop specialists might also be required to visit farms in certain cases to verify the type of soil texture on the farm in question.

HYPOTHETICAL REPRESENTATION OF THE ADMINISTRATION OF THE PROPOSED DROUGHT SCHEME ON A TOWNSHIP GRID

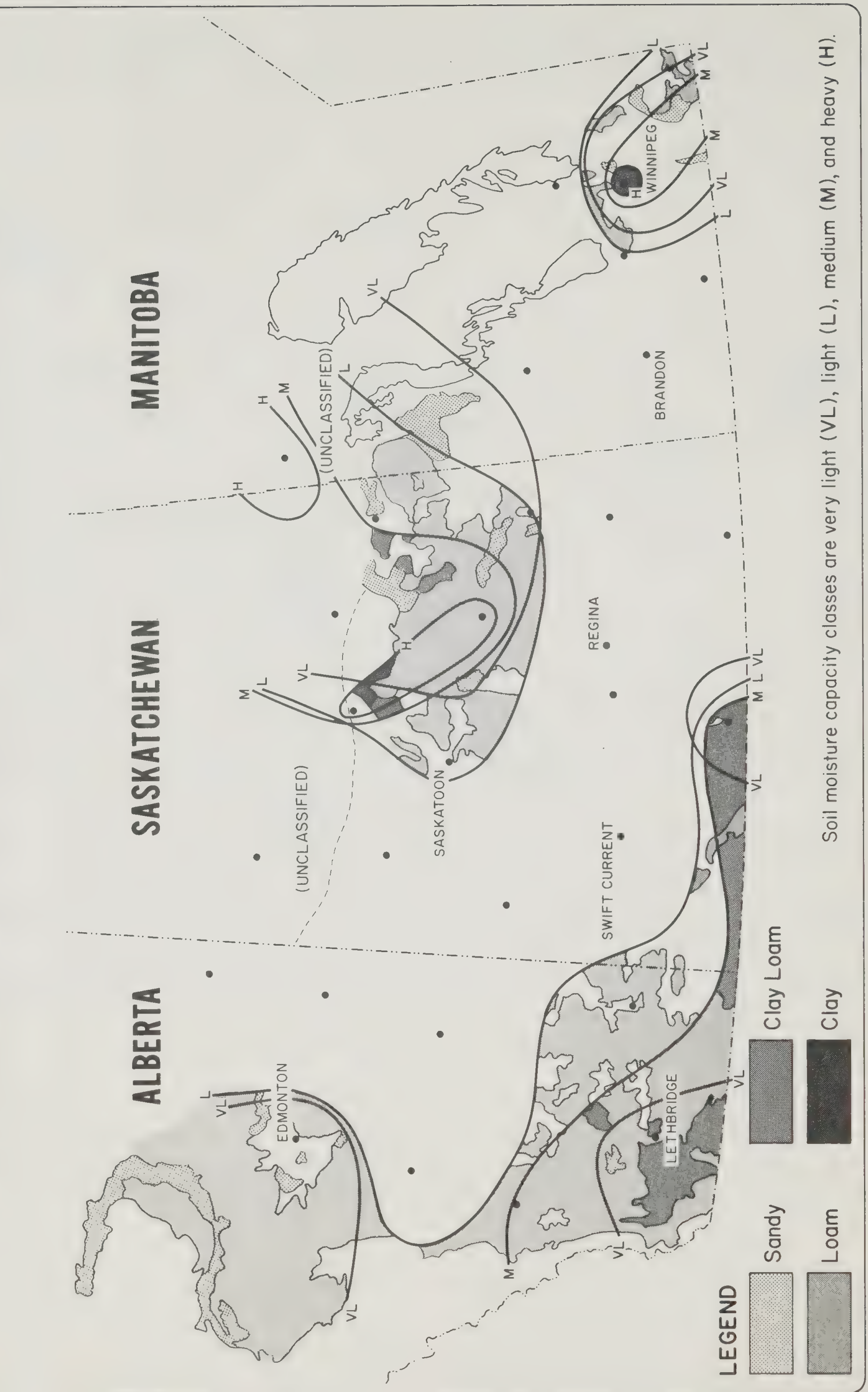


Represents all townships declared eligible for compensation

SOIL TEXTURE NUMBER	SOIL TEXTURE CLASS	WATER-HOLDING CAPACITY (mm)	ISOLINE
1	Sandy	100	I-1
2	Loam	150	I-2
3	Clay Loam	200	I-3
4	Clay	250	I-4

Figure 2

DESIGNATED DROUGHT AREAS IN THE PRAIRIE PROVINCES FOR 1976 USING WEATHER-BASED MOISTURE RESERVE ESTIMATES AND SOIL TEXTURES



Soil moisture capacity classes are very light (VL), light (L), medium (M), and heavy (H).

Figure 3

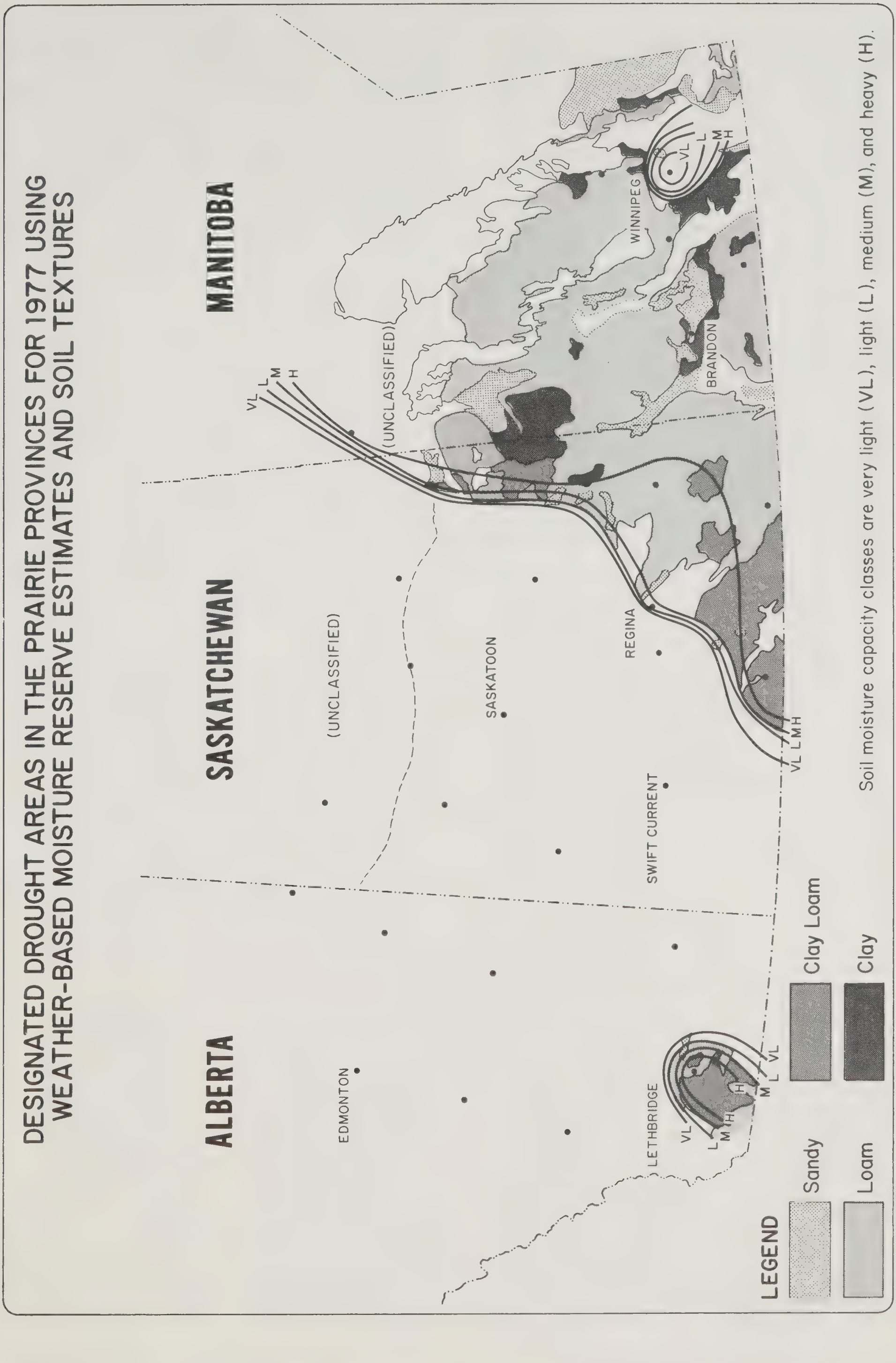

DESIGNATED DROUGHT AREAS IN THE PRAIRIE PROVINCES FOR 1977 USING WEATHER-BASED MOISTURE RESERVE ESTIMATES AND SOIL TEXTURES
ALBERTA
SASKATCHEWAN
MANITOBA
EDMONTON
LETHBRIDGE
(UNCLASSIFIED)
SASKATOON
SWIFT CURRENT
REGINA
(UNCLASSIFIED)
BRANDON
WINNIPEG
VL L M H
LEGEND
Sandy
Loam
Clay Loam
Clay
Soil moisture capacity classes are very light (VL), light (L), medium (M), and heavy (H).

Figure 4

2. Additional precipitation measurements other than those used in this analysis could establish whether or not the farm involved was in a lower rainfall area not indicated by the precipitation records used in this scheme. Such data could include localized precipitation readings from standard climatic stations not previously included in the establishment of the isolines, as well as from elevator points close to the farm.
3. Soil survey information too detailed to initially incorporate into the scheme could also be used.

SAMPLE MAPS

We have demonstrated the scheme for 2 years. The drought zone was applied to weather records from 1976 and 1977 and shown in Figures 3 and 4. The criteria used to draw the isolines are 60% of normal soil moisture on heavy and medium soils, 50% of normal on light soils, and 30% on very light soils. Under these criteria drought can be expected approximately one year in three at most sites. As a result, these criteria are more lenient than drought administrators might normally desire. If the criteria were chosen on a one-year-in-five basis, for example, instead of a one-year-in-three, then designated drought areas would be smaller.

The 2 years demonstrate that by normalizing (expressing as percent of the average) the soil moisture estimates, areas requiring drought assistance are not confined to the normally dry regions (Figure 1). The drought areas defined are noticeably different for the 2 years. The drought areas are slightly more extensive on lighter soils despite having less restrictive criteria on the heavier soils. This is due to the varying effects that extremely wet years have on normal estimates. Figures 3 and 4 only demonstrate part of the overlay procedure. The more dense network of precipitation sites required to revise the isolines were not available for this demonstration. Therefore, the isolines did not have the necessary precision to justify the overlay on the township base map. These maps are only intended to illustrate general trends in broad areas designated as drought and should not be used in any detailed interpretation.

SUMMARY AND CONCLUSIONS

The scheme proposed here for defining drought areas incorporates all environmental factors affecting drought. The scheme is specific to forage production; however, the general concepts could be applied to other corps. Although it does not solve the problem of having to designate one farmer as eligible and his neighbor as ineligible for assistance, the rationale for making such decisions is much improved. The scheme allows for consideration of the regional soil type and climatic differences. Defining drought areas on the basis of different soil types and normalizing the soil moisture estimates for each soil allows for a flexible drought delineating scheme. The scheme provides a more comprehensive definition of drought than is possible with only precipitation records.

The scheme has two features designated to overcome the weakness of making a detailed (township or farm level) interpretation of a meso-scale weather data base. By introducing the soil property which most influences the impact of drought on forage yields (that is, water-holding capacity) more emphasis is put on soil boundaries and less on weather. The second is the provision for revising the soil moisture isolines with a denser network of precipitation recording sites.

Ideally, a drought assistance program should take into account the economic impact of drought as well as delineate drought areas. A detailed economic analysis for current year situations at the farm level, however, is extremely difficult. The long-term economic consequences of drought assistance could be assessed if the risk of drought occurrence, as defined in the scheme, was understood. A procedure for selecting criteria for drought, based on the long-term risk of those criteria being met, would be a useful addition to the scheme. Such a procedure will be described in a subsequent paper.

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Economic analysis of rapeseed meal and fishmeal as protein supplements in chicken broiler diets

Economic returns of chicken broilers on a diet containing soybean meal (SBM) as the primary protein source and nine dietary regimens with various levels of rapeseed meal (RSM) and fishmeal (FM) as direct substitutes for SBM were estimated using Kentville Research Station experimental data. A description of nutrient content of each diet and a summary of the empirical results follow. The review focuses on the economic incentives associated with the use of RSM and highlights some of the reasons why RSM is not being included at higher levels in least-cost diet formulations. The empirical results provide additional insights for the poultry producer (in relation to the consumer) on expenditure for poultry feed and particularly on the total cost of chicken broiler production.

The authors wish to thank Co-Op Atlantic, Moncton, New Brunswick, for the use of their least-cost feed formulation computer programs.

S. Al Hassan, K.B. McRae, H.W. Hulan, and F.G. Proudfoot

INTRODUCTION

Recent improvement in the nutritional value of rapeseed meal (RSM) should increase its use as livestock feed and should lessen the dependence on imported soybeans as the main economic source of protein in Canada. Studies on the effects of earlier varieties of RSM, high in erucic acid and glucosinolates, resulted in reduced performance when fed to chicken broilers. Lodhi *et al*. (1970) reported that protein assimilation in chicken is less for rapeseed meal than for soybean meal (SBM). Tao *et al*. (1971) observed low performance in chicken broilers when RSM is fed.

The development of new rapeseed varieties with low levels of erucic acid and glucosinolates, that is, *Brassica napus* (Tower rapeseed) and *B. campestris* (Candle rapeseed), has reduced the adverse effects of RSM so that RSM is now a viable replacement for soybean meal in poultry diets. Recent research on chicken broiler response to these varieties of RSM shows that inclusion of RSM in diets can be economically advantageous to Canadian farmers. March *et al.* (1975) observed that amino acid supplementation by a RSM diet significantly improves performance. Olomu *et al.* (1974) also reported significant improvement in the performance of chicks when RSM diets are supplemented with some amino acids, especially arginine and methionine.

Recently, Hulan and Proudfoot (1981) conducted additional experiments at the Agriculture Canada Research Station, Kentville, Nova Scotia, to evaluate the performance of chicken broilers fed diets containing various levels of RSM, fat, and fishmeal (FM) as

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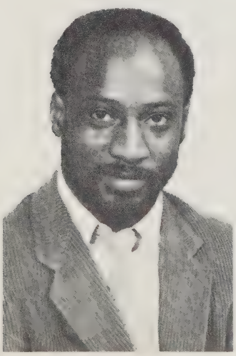


replacement for soybean meal. This research shows that RSM can replace substantial portions of SBM in chicken broiler diets and still maintain high performance, provided nutritional balance is maintained by additions of fishmeal. Similar results for turkey broilers were found by Hulan *et al.* (1980).

This paper augments the Kentville experimental data with dietary costs to demonstrate the price relationship for and the economic plausibility of RSM and FM as complementary sources of dietary protein in chicken diets. A standard least-cost feed formulation program did not select RSM as a major ingredient, given the same conditions as the Kentville experiments. Only when the National Research Council's (NRC's) recommended level of amino acids was relaxed was RSM included in the least-cost formulation.

EXPERIMENTAL OVERVIEW

A total of 936 Hubbard chicks in Experiment 1 and 1600 Cobb chickens in Experiment 2, with equal numbers of each sex intermingled in each pen, were used to evaluate the effect of 9 different diets in Experiment 1 and 10 diets in Experiment 2. Standard (basal) starter and finisher diets were fed as a control regimen and their composition was subsequently changed to include various levels of RSM, fishmeal, and fat as a replacement for SBM and corn (protein + energy). Table 1 provides the percentage ingredient composition of the control diet while Table 2 depicts the replacement rates of RSM and FM and SBM in the control diet. The protein level was constant for starters at 24 percent and finishers at 16 percent (Table 2). The level of fishmeal and animal fat increased in proportion to the level of RSM to make the diets both isonitrogenous and isocaloric.

TABLE 1. INGREDIENT COMPOSITION OF THE CONTROL DIET

Ingredient	Starter	Finisher
	percent	
Ground corn	30.0	56.2
Ground wheat	26.5	22.0
Soybean meal (44%)	33.5	10.5
Fishmeal (63%)	5.0	5.0
Stabilized animal fat	2.0	3.2
Ground limestone	0.9	0.8
Dicalcium phosphate	0.6	0.8
Iodized salt	0.5	0.5
Vitamin-mineral premix	1.0	1.0
Calculated analyses:		
Metabolizable energy (MJ/kg)	12.43	13.57
Crude protein (%)	24.0	16.0

Source: H.W. Hulan and F.G. Proudfoot (1981).

The formulated diets were fed to chicken broilers up to 49 days of age and showed no significant differences in live weight, mortality feed conversion, and performance. In essence, the experiment demonstrated that when supplemented with FM, RSM from both Tower and Candle cultivars is within sampling variation of being nutritionally as good as SBM diets. The paper (Hulan and Proudfoot, 1981) claims that acceptable amino acid balance can be achieved through the addition of FM. If so, this approach would avoid the need to add amino acids in crystalline form, which is an expensive source of amino acids and may be considered by the feed industry to be impractical.

Nutritional equivalence of itself will not overcome the reluctance to include RSM in broiler diets, but economic competitiveness must be shown to feed manufacturers and poultry producers alike. Whenever alternatives exist for feed ingredients, least-cost feed blending can and should be considered, especially if the efficiency of the feedstuffs has been biologically evaluated through experimentation, such as that conducted by Hulan and Proudfoot (1981). Feed cost minimization should be an ongoing concern in the broiler industry because it is still the single most important component of production costs. The economic advantage of lower RSM diet costs might overcome the reluctance of poultry growers to feed RSM.

DATA AND EVALUATION METHOD

A linear-programming technique was used to evaluate and compare least-cost feed formulations which contain specified levels of RSM but were not constrained to meet the NRC's requirements for amino acids. Protein and energy levels were met for each diet.

LINEAR PROGRAMMING APPROACH

A least-cost computer program is the principal tool used to evaluate the costs of various combinations of feed ingredients which meet the nutritional requirements accepted by a livestock industry. Given the specification of the nutritional requirements of the animal, the ingredient prices and the nutrient analysis of the available feedstuffs, the program chooses among alternative feed ingredients and provides the cost or least-cost feed formulation. The program assumes that the specified nutrients of these ingredients are available to the animal. In general, the bioavailability of the nutrients is difficult to determine experimentally and often chemical determinations are used instead. Therefore, the actual performance on the derived feed combinations can only be determined after extensive experimentation. Nonetheless, the linear programming solution provides guidelines for diet formulations which fulfill the animal's minimum nutrient requirements.

TABLE 2. PERCENT REPLACEMENT OF SOYBEAN MEAL WITH RAPESEED MEAL IN CHICKEN BROILER DIETS

Diet	Starters				Finishers			
	SM[a]	RSM[b]	FM[c]	FAT	SM	RSM	FM	FAT
				percent				
Control	33.5	–	5.0	2.0	10.5	–	5.0	3.2
+ 20% Tower[s]	26.8	6.7	5.5	2.5	8.4	2.1	5.3	3.5
+ 40% Tower	20.1	13.4	6.0	3.5	6.3	4.2	5.6	3.8
+ 60% Tower	13.4	20.1	7.0	4.5	4.2	6.3	6.0	4.2
+ 80% Tower	6.7	26.8	8.0	5.5	2.1	8.4	6.4	4.6
+ 100% Tower	–	33.5	9.0	6.5	–	10.5	6.8	4.9
+ 20% Candle[s]	26.8	6.7	5.5	2.5	8.4	2.1	5.3	3.5
+ 40% Candle	20.1	13.4	6.0	3.5	6.3	4.2	5.6	3.8
+ 60% Candle	13.4	20.1	7.0	4.5	4.2	6.3	6.0	4.2
+ 80% Candle	6.7	26.8	8.0	5.5	2.1	8.4	6.4	4.6
Calculated analyses:				Starters		Finishers		
Crude protein (%)				24.0		16.0		
Metabolizable energy (MJ/kg)				12.43		13.57		

Source: H.W. Hulan and F.G. Proudfoot (1981).
[a]SM = soybean meal (44%). [c]FM = fishmeal.
[b]RSM = rapeseed meal (38%). S = rapeseed cultivar.

The performance data from the chicken broiler experiments of Hulan and Proudfoot (1981) were used in a least-cost feed formulation program developed by Co-Op Atlantic in Moncton, New Brunswick. Unlike most least-cost feed formulation recommendations, however, the Kentville experimental data incorporate an RSM constraint and also specify the ingredients and their respective quantities.

Using September, 1980 market prices of corn at \$200.95/t, SBM (44 percent) selling for \$389.65/t, ground wheat at \$215.80/t, RSM (38 percent) at \$252.87/t, fat at \$435.00/t and fishmeal at \$500.00/t, the costs of one tonne of the constrained least-cost diets are given in Table 3. Ground wheat has not been included in the feedmix because of its relative price and efficiency compared with other ingredients (Table 1). Nutrient analysis and suggested broiler nutrient requirements are expressed in percentages and energy in Kilo calories (Table 4). Table 5 depicts the expected returns above feed costs for the various RSM diets based on the Kentville performance data. The diet with 100 percent RSM substitution has the highest returns while diet 1 ranks sixth.

Figure 1 depicts the cost components of variable ingredients of the Kentville diets over time. Diets without SBM contain RSM, fishmeal, and fat. The ingredients which are replaced in the control diet are SBM and corn. The product of the coefficients and their respective ingredient prices per tonne for the 12-month period mentioned earlier describes the trend of ingredient costs over time.

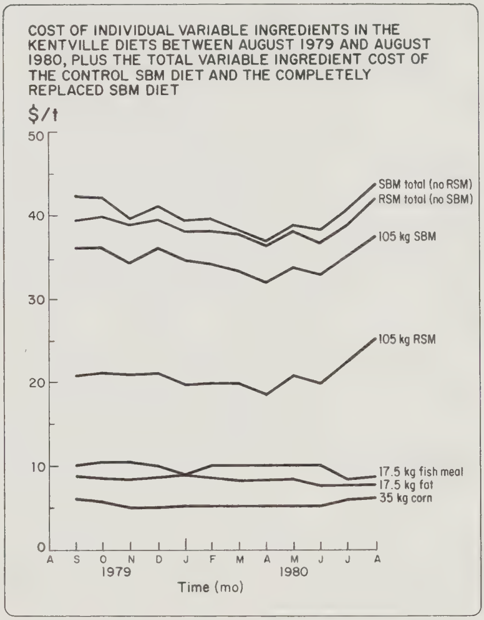

Figure 1

TABLE 3. INGREDIENTS AND TOTAL COST OF LEAST-COST FORMULATED DIETS CONTAINING PRESCRIBED MINIMUM LEVELS OF RAPESEED MEAL, BUT NOT CONSTRAINED TO MEET NRC RECOMMENDED AMINO ACID LEVELS

Ingredient	Price per Tonne[a]	Control	Starter 20%	40%	60%	80%	100%	Control	Finisher 20%	40%	60%	80%	100%
	–$–	–					kilograms						–
Corn	200.95	–	–	–	–	–	407	784	781	776	772	768	604
Wheat	215.80	678	659	644	626	609	–	–	–	–	–	–	–
SBM	389.65	181	158	134	110	87	–	100	80	60	40	20	–
RSM	252.87	–	36	72	109	145	430	–	20	40	60	80	271
FM	500.00	95	95	95	95	95	65	70	74	78	82	85	8
Fat	435.00	30	35	39	44	49	80	21	22	24	25	27	80
Other ingredients (constant)	–	16	17	16	16	16	18	25	23	21	22	20	37
	–						dollars						–
Cost/t ($)	–	287.42	285.80	284.17	282.49	280.87	268.19	252.27	250.95	249.63	248.32	247.09	242.87

[a]September 1980.

Corn, fishmeal, and fat maintain a fairly stable price over the period while SBM and RSM prices seem to rise and fall together. The most important feature of the cost curves is that the diet in which some or all the SBM is replaced costs about $2.00/t less than the control (no RSM) diet.

At the producer level, feed cost will decrease about $800 a year if the farm unit uses 3.96 kg of feed per bird and grows 30 000 broilers per crop and 3.5 crops a year. Alternatively, of the estimated 280 million chicken broilers reared in Canada in 1980, feed cost could have been reduced about $2 217 600 if rapeseed meal had been included in the feed mix. If extended to include all national broiler producers, feed manufacturers, and the oil-seed industry, the contribution of rapeseed to the gross national product could be remarkable.

The flexibility of the feeding programs within the range of the experiment shows that it is reasonable and profitable to shift rations as prices of the ingredients change, and more importantly, that rapeseed meal (a Canadian ingredient) is a competitive, efficient, and economical source of protein.

The effect of the prices of the five variable ingredients of the Kentville experimental diet(s) – SBM, corn, fishmeal, RSM, and fat – can be expressed in a simple mathematical equation:

1. PSBM = 10.5% PSM + 3.5% PC
2. PRSM = 10.5% RSM + 1.8% PFM + 1.7% PF

for the SBM and RSM diets respectively, where

PSBM = the price of the variable ingredients in the SBM diet,
PRSM = the price of the variable ingredients in the RSM diet,
PC = the price of corn,
PFM = the price of fishmeal, and
PF = the price of fat.

The price differential (PD) between any fractional substitution (f) is given by the following:

3. PD = f. (PSBM-PRSM), where $0<f<1$.

Given the rate of ingredient substitution and ingredient prices, the above equations permit a ready estimation of a diet's cost. The equations are constructed on the basis that the prices of RSM and fishmeal and SBM are independent of the prices of wheat, corn, and the other ingredients in the starter diets, while corn and SBM prices are dependent on one another in the finisher diets. Table 6 and 7 show the percent diet composition.

As an example, when the price of corn = $181.71/t, fishmeal = $519.80/t, SBM = $359.79/t, fat = $440.92/t, and RSM = $242.94/t, then PSBM = $44.14/t and PRSM = $42.37/t. This leads to the conclusion that an RSM diet is expected to increase net returns by $1.77/t of feed consumed.

The essence of these equations is twofold. First, they readily permit estimation of the effect of anticipated change in ingredient prices on feed costs; second, the quantity and value of the ingredients can be used to choose the substitution level.

DISCUSSION AND CONCLUSION

Analysis of the experimental performance data shows that Tower rapeseed, Candle rapeseed, or blends of RSM (that is Canola) are competitive with soybean meal as alternate protein sources in diets fed to chicken broilers. The present analysis demonstrates that in addition to the attractive biological performance of chicken broilers on diets containing RSM, the diets simultaneously provide a superior economic return than diets using only soybean meal as the protein source.

TABLE 4. CALCULATED PROTEIN-AMINO ACID PROFILE OF DIETARY SOURCE AND OF INDIVIDUAL DIETS EXPRESSED AS A PERCENTAGE OF NRC SUGGESTED REQUIREMENTS. (Formulation of each diet is based on least-cost subject to a prescribed minimum level of RSM. Blanks in the amino acid profile indicate that the diet exceeds the NRC suggested minimum requirement.)

Nutrients	NRC Suggested Requirements for Chicken Broilers		% Composition			Protein and Amino Acid Profile as % of NRC Requirements											
						Starter						Finisher					
	0-4 wk	5-7 wk	(RSM) Canola	SBM[a]	FM[b]	Con-trol	.2	.4	.6	.8	1.0	Con-trol	.2	.4	.6	.8	1.0
						percent											
Protein (N x 6.25)	(23.0)	(16.0)	(38.00)	(47.50)	(63.0)	(104)	(104)	(104)	(104)	(104)	(104)	(100)	(100)	(100)	(100)	(100)	(100)
Amino acids																	
Arginine	1.44	1.20	2.21	2.90	3.20	86	87	88	88	89	—	71	65	68	72	72	80
Cystine	0.25	0.15	0.47	0.29	0.56	—	—	—	—	—	—	—	—	—	—	—	—
Glycine	1.00	0.75	1.89	2.07	4.19	—	—	—	—	—	—	—	—	—	—	—	—
Histidine	0.35	0.3	1.03	1.08	1.30	—	—	—	—	—	—	—	—	—	—	—	—
Isoleucine	0.80	0.70	1.51	2.11	2.60	—	—	—	—	—	—	90	87	87	89	87	87
Leucine	1.35	1.18	2.65	3.37	4.50	—	—	—	—	—	—	—	—	—	—	—	—
Lysine	1.20	1.00	2.12	2.80	4.75	—	—	—	—	—	—	80	74	78	81	81	75
Methionine	0.70	0.60	0.68	0.68	1.70	60	61	61	63	64	70	53	57	58	58	58	52
Phenylalanine	1.00	1.00	1.52	2.16	2.30	—	—	99	99	98	96	68	66	66	67	67	67
Serine	0.50	0.25	1.67	2.25	2.25	—	—	—	—	—	—	—	—	—	—	—	—
Threonine	0.75	0.65	1.71	1.71	2.50	—	—	—	—	—	—	89	86	89	94	97	89
Tryptophan	0.23	0.20	0.44	0.54	0.65	—	—	—	—	—	—	75	90	85	80	80	75
Valine	0.82	0.72	0.94	1.26	3.00	—	—	—	—	—	—	—	—	—	—	—	—

[a]*Canadian Rapeseed Meal, Poultry and Animal Feeding,* Pub. No. 51, Canola Council of Canada.
[b]Dr. H.W. Hulan (unpublished data).

TABLE 5. EXPECTED RETURNS ABOVE FEED COSTS[a] OF LEAST-COST FORMULATIONS FOR FIXED LEVELS OF SBM SUBSTITUTION (ASSUMING THE KENTVILLE EXPERIMENTAL PERFORMANCE DATA)

Diet	Diets (Substitution Rate of SBM with RSM in Standard Diet)[b]	Feed Cost Starter	Feed Cost Finisher	Total Feed Consumed	Live Body Weight	Return above Feed Cost
		— ¢/kg	—	— kg	—	¢ /kg
1	Control	28.74	25.23	3.98	1.95	75.12
2	20%	28.58	25.10	3.98	1.95	75.76
3	40%	28.42	24.96	3.98	1.95	76.25
4	60%	28.25	24.83	3.98	1.95	76.81
5	80%	28.09	24.71	3.98	1.95	77.34
6	100%	26.82	24.29	3.98	1.95	80.02

[a]Feed conversion ratio (FCR) = 2.04, broiler returns @92.16¢ /kg. Of the total feed fed, 30 percent is starter and 70 percent is finisher.
[b]These assume isocaloric, isonitrogenous diets and nutritionally balanced diets.

TABLE 6. COMPOSITION OF STARTER DIETS

Ingredient	A3 Control	20% Tower	40% Tower	60% Tower	80% Tower	100% Tower	20% Candle	40% Candle	60% Candle	80% Candle
					kg/t					
Ground corn	300	290	275	255	235	215	290	275	255	235
Ground wheat	265	265	265	265	265	265	265	265	265	265
Soybean meal (44%)	335	268	201	134	67	—	268	201	134	67
Fishmeal (63%)	50	55	60	70	80	90	55	60	70	80
Tower RSM	—	67	134	201	268	335	—	—	—	—
Candle RSM	—	—	—	—	—	—	67	134	201	268
Poultry grease	20	25	35	45	55	65	25	35	45	55
Limestone	9	9	9	9	9	9	9	9	9	9
Dicalcium phosphate	6	6	6	6	6	6	6	6	6	6
Iodized salt	5	5	5	5	5	5	5	5	5	5
Vitamin: mineral premix	10	10	10	10	10	10	10	10	10	10
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

TABLE 7. COMPOSITION OF FINISHER DIETS

Ingredient	A4 Control	20% Tower	40% Tower	60% Tower	80% Tower	100% Tower	20% Candle	40% Candle	60% Candle	80% Candle
					kg/t					
Ground corn	562	556	550	542	534	527	556	550	542	534
Ground wheat	220	220	220	220	220	220	220	220	220	220
Soybean meal (44%)	105	84	63	42	21	—	84	63	42	21
Fishmeal (63%)	50	53	56	60	64	68	53	56	60	64
Tower RSM	—	21	42	63	84	105	—	—	—	—
Candle RSM	—	—	—	—	—	—	21	42	63	84
Poultry grease	32	35	38	42	46	49	35	38	42	46
Limestone	8	8	8	8	8	8	8	8	8	8
Dicalcium phosphate	8	8	8	8	8	8	8	8	8	8
Iodized salt	5	5	5	5	5	5	5	5	5	5
Vitamin: mineral premix	10	10	10	10	10	10	10	10	10	10
Total kg	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Source: Hulan and Proudfoot (1981).

In order that the poultry industry can use RSM meal, some equitable reporting on the actual quality or composition of RSM must be given in scientific journals and texts. Quite frequently, feed analysts, feed textbooks, such as Feeds and Feeding (Cullison), and feed manufacturers either fail to include RSM on their list of ingredients or if and when they do, the actual nutrient composition is understated. This nutritional understatement eliminates RSM from being included in a true least-cost feed formulation. Similarly, taking NRC

recommended nutritional levels literally in least-cost feed formulation programs will have the same result. Improvement in broiler strains appears to be reducing the nutritional requirements. If Canadian self-sufficiency in poultry feedstuffs is of concern, then it is important that the feed manufacturers be able to update their computer data bases with both the nutritional composition of the new varieties of RSM and the nutritional requirements of new broiler strains for proper least-cost feed formulation.

The Kentville experimentally proved diet, which uses RSM and FM to replace SM as the protein source, was shown to have a $1.77/t price advantage using 1980 costs. If the Kentville control diets were formulated using SM containing 48.5 percent protein rather than 44.0 percent protein this margin would be slightly less. Since the Kentville RSM diet was not formulated to be least cost, it can be expected that this margin could be increased further with refinement in diet formulation.

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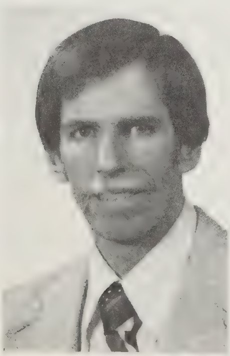
Proposal for a target level for frozen chicken storage stocks

The Canadian Chicken Marketing Agency's Supply Management Committee makes recommendations on quarterly production quota requirements. Integral to such recommendations is a target level of frozen storage stocks at the end of the quota period. Because the storage stock level affects industry profitability, consumer prices, imports, and other considerations, it is important to select an appropriate storage stock target. This article outlines a proposal for a target storage stock level based on the historical relationship between stocks and processor price margins.

P.K. Blakely

BACKGROUND

On a quarterly basis, the Supply Management Committee (SMC) of the Canadian Chicken Marketing Agency (CCMA) makes recommendations to the Agency on chicken production requirements. Decisions on chicken production quota must account not only for projections of expected consumption, but also for expected total supplies. Total supplies are the sum of domestic production, imports, and frozen storage stocks at the beginning of the quota period. Because chicken is on the import control list, a benchmark on the import magnitude is provided. In 1981, import quota is 52.0 million pounds; thereafter, import quota will be set at a figure equal to 6.3 percent of the previous year's domestic production. If a benchmark can also be provided on a target level for frozen storage stocks, the SMC will have a frame of reference defined for determining production quota.



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Quarterly production would be set at a level equal to estimated consumption minus imports plus exports (usually negligible), plus any storage stock adjustment required to bring actual current stocks into line with target levels. This procedure does not suggest that frozen storage stocks are a perfect substitute for fresh product and that a pound for pound reduction in fresh product quota will result in an equivalent reduction in frozen stocks. It is suggested, rather, as an operating principle required in setting production quota. The proposed target level of storage stocks should be reviewed over time as to its effect on all chicken industry segments.

Unquestionably the target level of storage stocks affects all chicken industry segments. Storage stocks are a barometer of the industry's health. Outside a normal range, stock levels are indicative of stress in the marketplace. Low storage stock levels are symptomatic of rapidly rising prices at all market levels as buyers compete for available supplies. Additionally, because low storage stock levels are associated with regional shortages of product types, there is a consequent increase in applications for supplementary imports (beyond the negotiated import entitlements). Competition for reduced supplies of live birds encourages processors to offer to producers premiums above the prices determined by the cost of production.

In contrast, high storage stock levels are symptomatic of losses to the processing industry. As processors attempt to rid themselves of burdensome stocks, downward pressure is placed on their selling price. At the producer level, birds are often backed up at the farm, resulting in disease problems, overcrowding, increased mortality, quality losses, increased feed costs, and scheduling problems for replacement chicks.

The essential issue is to determine the normal range of storage stock levels. Conceptually, an appropriate storage stock volume would be done that tends to be associated with average returns in the various segments of the chicken industry, that is, a volume that adequately lubricates the marketing and distribution pipeline. One method of determining an appropriate storage stock level would be to examine the level of storage stocks, by quarter, for an historical period. If a negative relationship can be established, as has been suggested, between storage stock levels and industry returns to investment, then it can be assumed that over the historical period, the average storage stock level tends to be associated with average industry returns.

Such a simplistic analysis would suggest the use of the 10-year average stock level if a relationship between stocks and industry returns is determined. There are, however, a few wrinkles.

The National Supply Management Program

First, the introduction of a national supply management program changed the structure of the industry in a way that could affect the level of storage stocks. Before the national agency's formation, provincial boards could pursue independent production decisions. It can be argued that historically, storage stock levels were a *residual* between supply and demand. The fact that national supply was determined by the sum of independent provincial actions with a variety of possible motivations suggests that some long-run average of stocks might be appropriate. That average should be adjusted to reflect seasonal demand differences and secular market growth. With nationally coordinated production, the residual can be redistributed, based on expected demand.

Frozen or Fresh

Second, even some of those in favor of the approach which would estimate appropriate storage stock volumes as that level which provides a well lubricated marketing pipeline argue that frozen and fresh product markets must be differentiated. In some of the western provinces, almost all the retail market is for chicken in its frozen form. In such a market almost all product is frozen as part of routine processing. As a proportion of sales, frozen stocks can be expected to be higher than that proportion prevailing in markets where the product is marketed fresh. In the latter case, product is frozen primarily because of a lack of synchronization between live product input into the processing plant and fresh marketings, the primary output of the processing plant.

Regardless of whether a province markets chicken as fresh or frozen, however, on a national basis a differentiation between the two markets is not necessary to the analysis as long as the provinces do not change from marketing one product form to the other. Nationally, it matters not whether the target of national stocks is the sum of that placed in storage only because of the absence of immediate marketing requirements (fresh markets) plus that placed in storage because of routine processing (frozen markets). If, however, British Columbia, for example, changes from frozen to fresh chicken marketing, the national target level of storage stocks can be adjusted downward by an amount that would reflect the difference in the average proportion of stocks to production in fresh versus frozen product provinces.

Seasonal Demand

Third, storage stock target levels should reflect the fact that chicken demand is seasonal. At any given time a certain production percentage could be expected to be placed in storage. Use of a constant percentage of production would ensure that stock target levels would grow as production quota is increased in anticipation of a seasonal rise in demand.

Below Historical Average

Fourth, there is some justification in recommending a target stock level somewhat below the average of some historical period. Under supply management in the absence of negotiated producer prices in Ontario, processors bear a larger share of market risk than would be the case with negotiated producer prices. In deference to this added risk, it is considered appropriate to recommend a storage stock level slightly lower than the historical average to confer to the processing industry a risk premium.

DETAILED PROPOSAL: THE LEVEL OF FROZEN STORAGE STOCKS

Under supply management, the seasonal production pattern is intended to closely correspond with the seasonal consumption pattern. There is an unnecessary expense incurred in storing chicken when production exceeds consumption until such time that these inventories may be drawn down when the situation is reversed.[1] If production is geared to consumption, then it would be necessary for processors to maintain only a certain constant percentage of production to meet daily requirements.

It may be possible to determine the best ratio of stocks to production by observing what has occurred historically.

During a typical year, processors tended to accumulate product in storage during periods of slack demand. Following the relatively weak demand period in the

[1]The case might be made that production should be geared to increasing the economies of scale, from hatchery through processing levels in the marketing chain, and that this would lead to production levels which would not be equated with expected consumption within quarterly periods. In such a case, storage stocks would be viewed as serving a less costly residual function. Such a system does not recognize the preference for fresh product or the political realities of supply management.

fall, storage stocks tended to be high on January 1. In contrast, following the peak demand period of summer, storage stocks tended to be relatively low on October 1. Under national supply management, with seasonal production set equal to expected consumption, a redistribution of stocks throughout the year would be preferable. It is assumed, however, that on balance, storage stocks as a proportion of production over the calendar year may have been a reasonable amount (or slightly higher than ideal for the reasons already presented). This assumption is supported by theory: storage stocks as a proportion of production should support a profit level which covers costs over the long run. If the ratio generated excessive profits, firms would enter the processing industry and thereby reduce profitability. If the ratio generated negative returns, over the long run there would not be any firms in the business. It is in this sense that average stock levels are associated with average returns. Such an assumption leads to the proposal that stocks at the end of each calendar quarter be added, and that the sum be divided by the national annual production. This will yield an average ratio of stocks to production, which as a target, should prevail in each quarter, providing that seasonal production is set on the basis of seasonal consumption under supply management.

Between 1970 and 1979, the annual ratio varied between .103 (in 1978) and .193 (in 1979). (Refer to Figure 1 for a listing of the ratio in each year.)

If the ratios for each year are listed in ascending order, a frequency distribution is created. In Figure 2, lines called fractiles, drawn through this distribution, indicate the percentage of time the ratio has fallen below the ratio represented by the fractile line. Referring to Figure 2, for example, it can be observed that in 3 years out of 10, the ratio was below that represented by the 30 percent fractile. The 30 percent fractile represents the ratio calculated by averaging the third and fourth years in the distribution. Similarly, the 40 percent fractile, representing a ratio which is the average of those in the fourth and fifth years, indicates a ratio below which were 4 years out of the past 10.

Recalling that the appropriate storage stock level should be one which provides a reasonable return to all industry segments, gross processor margins were used as a proxy variable for industry returns, after deflating the series by the wholesale chicken price. From 1970-79 a negative correlation coefficient of .66 was obtained between storage stock-production ratios at the end of a calendar quarter and the deflated gross processing margin in the preceding month. Because of this inverse relationship between the two series, the implication arises that the lower the fractile selected in the stock-production ratio distribution, the higher will be the margins realized by processors. For example, the 40

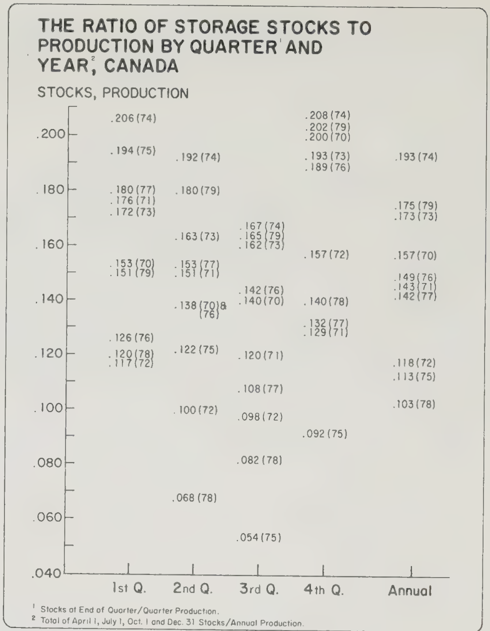

Figure 1

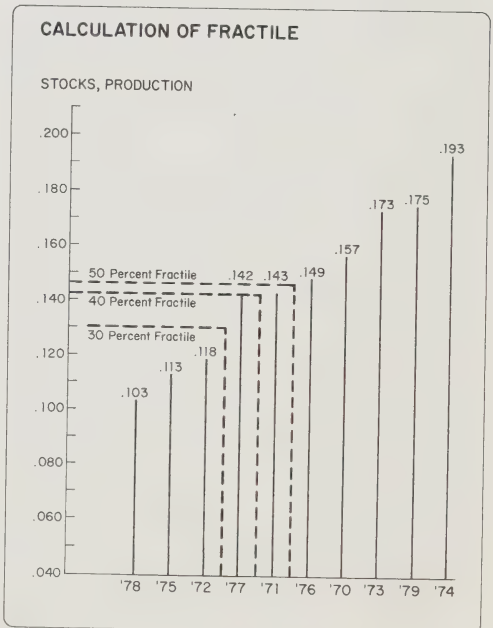

Figure 2

percent fractile indicates a ratio which over the long run would tend to confer to processors a gross margin, as a proportion of wholesale price which was exceeded four times out of the last 10 years.

It is proposed that a fractile of less than 50 percent be selected (though that is the fractile which would tend to be associated with average returns over the long run). To compensate processors for the larger share of market risk born under supply management, in the absence of negotiated producer prices, and to begin the target at a conservative level, the 30 percent fractile is recommended as a start-up target. The 30 percent fractile represents a stock-production ratio of 13.0 percent. An example may illuminate the proposal's operational details.

Implementation Proposal

Production and storage stock level determination requires import and domestic disappearance projections. The following example is suggested as fairly typical of how the recommended proposal would operate.

Assume the following:

1. It is mid-September, 1979, and the SMC must make recommendations on quota for the first quarter of 1980.
2. September 1, 1979 storage stocks are 38.7 million pounds.
3. Production quota for the fourth quarter of 1979 was previously set at 201.0 million pounds. With assumed fourth quarter imports of 12.0 million, zero exports, and expected disappearance of 218 million pounds, storage stocks during that quarter would have been reduced by 5 million pounds, implying an estimated January 1, 1980 storage stock figure of 38.7 − 5.0 = 33.7 million pounds.
4. Projected domestic disappearance for the first quarter of 1980 is 213 million pounds.
5. Import quota entitlements for the first quarter of 1980 are 12.1 million pounds.
6. Exports are expected to equal zero.

Given the above assumptions, the solution of the target storage stocks on April 1 and production for the first quarter of 1980 follows:

Supply	=	Demand
Production + estimated January 1, 1980 stocks + imports	=	Domestic disappearance + April, 1980 target stocks + exports
Production + 33.7 + 12.1	=	213 + (.13 × production) + 0
Production − (.13 × production)	=	213 − 33.7 − 12.1
.87 production	=	167.2
Production	=	167.2/.87 = 192.2 mil. lb
Target storage stocks	=	0.13 × production
	=	25.0 mil. lb

The assumed stock reduction during the fourth quarter of 1979 led to an estimated beginning storage stock level for the production period under consideration. Although storage stock estimates are difficult to forecast accurately, such an estimate is the preferred variable to use in the above calculations. The obvious alternative, use of the most recent storage stock observation – in this case September 1, 1979 – would not be appropriate since the stock reduction between September 1, 1979 and the target stock level on April 1, 1980 (the end of the first quarter production period) will be affected by production during the fourth quarter of 1979. By mid-September, that quota decision would have already been made and such information can be accounted for by the proposed method.

SUMMARY

The proposal for target storage stock determination is an attempt to link storage stock levels to production quota. We maintain that fresh and frozen markets need not be differentiated in proposing a target level unless a province changes from marketing one product form to the other. In such cases a simple adjustment to the target level can be made by adjusting the national target level by an amount equal to the difference between the stock-production ratios in fresh versus frozen markets multiplied by the provincial production in question.

Gross processor margins divided by wholesale price were used as a proxy for returns to the industry. A negative relationship was found between the stock - production ratio and gross processor returns. Since average returns are assumed to be earned over the long run in a competitive environment, an average return should be associated with average storage stock - production ratios. In recognition of processors' risk and a relatively conservative initial target, a stock level somewhat below average is proposed which would tend to confer a risk premium to processors. Finally, the historical seasonal pattern of storage stock levels has been redistributed away from the pattern which reflects stocks as a residual between consumption and production towards a target pattern of a constant percentage of production. This becomes an advisable and viable practice under a national supply managed system in which production is geared towards consumption within a relatively short production period. Price considerations enter the proposal implicitly. Disappearance projections which serve as a basis for setting quota, depend on a price assumption that covers production costs plus a reasonable return to producers.

CONCLUSION

The proposal is suggested as a starting point. If it happens that processor returns are too high, evidenced by supplementary import requests and the payment of producer premiums, the storage stock target should be raised. If, on the other hand, processor returns are too low, evidenced by interprovincial dumping allegations, bird back-up on farms, and low processor margins relative to past levels, the storage stock target level should be lowered.

Economic indicators

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1979 II	1979 III	1979 IV	1979 Annual	1980 I	1980 II	1980 III	1980 IV	1980 Annual	1981 I
Production and income											
1. GNP at market prices[a]	$ mil.	257 448[b]	266 624[b]	275 260[b]	261 961[b]	280 224[b]	284 368[b]	291 052[b]	303 792[b]	289 859[b]	314 956
2. Farm cash receipts, total[d]	$ mil.	3 301.3[b]	3 459.0[b]	4 095.7[b]	14 251.2[b]	3 798.8	3 460.0	3 948.6	4 430.2	15 637.6	4 939.7
3. – total crops[d]	$ mil.	1 212.6	1 479.6[b]	1 974.7[b]	6 121.5[b]	1 339.0	1 360.6	1 738.7	1 966.6	6 899.7	2 780.5
4. – total livestock[d]	$ mil.	1 950.9[b]	1 886.3[b]	2 031.8[b]	7 733.3[b]	1 900.7	1 974.6	2 118.1	2 324.3	8 317.7	2 073.5
5. Net income rec'd by farm operators[a]	$ mil.	4 180.0[b]	2 868.0[b]	3 936.0[b]	3 690.[b]	3 184.0[b]	2 788.0[b]	3 436.0[b]	3 263.0[b]	3 263.0[b]	4 448.0[b]
Trade											
6. Agricultural exports	$ mil.	1 354.7	1 663.9	1 884.8	6 107.8	1 501.5	2 008.2	2 003.5	2 331.4	7 844.6	1 906.6
7. Agricultural imports	$ mil.	1 181.6	1 129.4	1 240.4	4 680.6	1 158.9	1 256.9	1 173.6	1 517.8	5 107.2	1 406.5
8. Real domestic product, ag[a]	1971 = 100	104.9	105.5	112.4	108.1	110.4	109.6	107.7	109.4	109.3	114.8
9. Real dom. prod., less ag[a]	1971 = 100	138.9	140.8	140.4	139.7[b]	139.5	138.7	139.5	141.6	139.9	143.4
Price indexes											
10. Farm input price index	1971 = 100	234.4	236.1	239.6	234.9	253.2	250.3	258.6	267.5	257.4	280.8
11. – buildings and fencing	1971 = 100	233.2	229.5	235.3	226.0	235.5	236.4	242.2	242.7	239.2	247.3
12. – machinery & motor veh.	1971 = 100	191.8	196.2	205.3	193.3	214.2	221.7	227.0	237.4	225.1	248.0
13. – crop production	1971 = 100	252.5	258.5	266.5	254.0	296.9	309.1	304.9	310.7	305.4	329.2
14. – animal production	1971 = 100	252.3	249.2	247.8	249.0	252.7	232.8	256.2	266.8	252.1	269.9
15. – hired farm labor	1971 = 100	232.8	235.7	237.8	233.6	242.1	245.1	249.2	253.1	247.4	257.7
16. – interest	1971 = 100	395.3	395.3	395.3	395.3	466.7	460.9	448.7	473.1	462.4	553.7
17. Farm prices of ag. prod.[d]	1971 = 100	250.7[f]	247.7[f]	246.4[f]	298.8[f]	262.1[f]	255.9[f]	272.3[f]	290.7[f]	270.2[f]	287.9
Input and credit											
18. Farm impl. & equip. sales[e]	$ mil.	N.A.	N.A.	N.A.	1 701.0	N.A.	N.A.	N.A.	N.A.	1 745.0	N.A.
19. Employment in agriculture[a]	'000	489.3	475.7	481.0	483.8	490.0	478.0	466.0	478.0	478.0	477.0
20. Av. farm labor rates	$/h	3.95	4.01	4.08	3.98	4.15	4.22	4.24	4.31	4.23	437.0
21. Av. hourly earnings-manuf.	$/h	7.37	7.50	7.68	7.44	7.89	8.04	8.28	8.53	8.19	8.78
22. F.C.C. – gross loan disburs.	$ mil.	174.7	192.4	145.2	547.7	98.5	189.6	139.3	95.8	427.4	74.0
23. CPI – all items	1971 = 100	189.4	193.1	197.6	191.2	202.0	207.6	213.5	219.5	210.6	226.6
24. – food at home	1971 = 100	237.9	241.6	243.8	238.0	250.3	258.2	270.3	279.4	264.5	288.5
25. – food away from home	1971 = 100	220.8	227.3	232.4	223.4	237.1	240.7	246.6	251.8	244.1	257.3
26. Industry selling price index – food & beverage	1971 = 100	230.1	233.3	237.5	231.7	244.2	247.9	260.5[b]	273.8[b]	256.6[b]	275.5

continue

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1979				1980					1981
		II	III	IV	Annual	I	II	III	IV	Annual	I
Other indicators											
27. Unemployment rate	%	7.6	7.1	7.3	7.5	7.5	7.7	7.5	7.4	7.5	7.3
28. Exchange rate	$ U.S.	1.16	1.17	1.19	1.17	1.16	1.17	1.16	1.18	1.17	1.19
29. Chartered banks' rate on prime business loans	%	12.00[b]	12.67[b]	14.96[b]	12.91[b]	15.25[b]	14.58[b]	12.29[b]	14.92[b]	14.26[b]	18.08
30. Quarterly pop. est.	mil.	23.64	23.70	23.75	23.67	23.81	23.87	23.94	24.01	23.91	24.09

[a]Seasonally adjusted at annual rates.
[b]Revised.
[c]Preliminary.
[d]Excludes Newfoundland.
[e]Excluding repair parts.
[f]Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, Marketing & Economics Branch; Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

Notes

SAVING ON FERTILIZER BILLS

Manure has often been viewed by farmers as a nuisance, but today more of them are seeing it as a gold mine.

"Manure increases soil fertility and eases tillage, root penetration by plants, and seedling emergence," explains N.K. Patni, an animal waste specialist with Agriculture Canada's Animal Research Centre in Ottawa.

With prices for manufactured fertilizers rising rapidly, manure offers farmers a way to reduce expenses.

Dr. Patni says that 10 t of solid manure, or 25 m^3 of liquid manure, can provide the equivalent of up to 25 kg of nitrogen, 10 kg of phosphate, and 45 kg of potash. These fertilizers would cost around $40 at today's prices. Allowing for some loss of plant nutrients in handling manure, it would take only two dairy cows one year to produce this much.

Agriculture Canada scientists have been studying how manure use compares to conventional fertilizer applications. We seed 350 to 400 ha each year to silage corn. About one-quarter of this is fertilized with liquid manure only. Yields from manured fields have been as good as those from chemically-fertilized fields.

Between 8 000 and 10 000 gal/ac, or about 100 m^3/ha, are applied using a technique called rapid plowdown. Liquid manure is collected and hauled to the field in vacuum tankers and immediately plowed under. This method greatly reduces odor problems commonly associated with manure spreadling but, more importantly, it conserves plant nutrients in the soil by reducing losses to the air and in runoff water.

An alternative to the rapid plowdown method is to use a simple attachment to the bulk tanker which injects liquid manure into the soil. With the injector system, the manure is placed directly into the root zone of the soil so it is readily available to growing plants.

With row crops, the use of injectors permits manure application after planting so a farmer does not have to haul manure during the busy planting season. Manure can be injected between rows when the plants are between 10 and 30 cm high. Preliminary experience indicates that injection of liquid manure between rows is most satisfactory on relatively flat fields.

While the use of manure is more time consuming than chemical fertilizer use and may require additional machinery and storage facilities, over the long run, with proper planning it can often result in substantial cost savings.

WORKING WITH PEAT SOILS

In most parts of Canada, boggy areas are considered a hindrance to farming, but in Newfoundland, peat bogs could represent the best prospect for agricultural development. Newfoundland has an extremely high concentration of peatlands – about 2 million hectares – covering almost 10 percent of the total land area.

This abundance of peatland offers the greatest hope for expansion of Newfoundland agriculture. But much research is needed to reach this potential.

Scientists at Agriculture Canada's St. John's Research Station are meeting this challenge. Fred Rayment, an agronomist at the station, has been looking at ways of producing forage crops on peat soils. Different crops, such as vegetables, are being grown on a small scale on peat bogs. Presently, however, forage crops are the most widely grown. But there are still problems to be overcome with fertilizing and harvesting of forage crops on peat soils.

The lack of a forage harvesting system that will work economically on peat bogs is the main obstacle to expanding forage production.

The peat bog terrain will not support equipment carrying a heavy load of forage. Reinforced roads over the peat would be needed to support the load, but the construction of such roads would make production uneconomical.

Mr. Rayment has been studying other ways to move the forage. It's best if the forage is removed as hay or haylage because this cuts down the moisture content to 65 percent or less, therefore the final weight is less.

In the case of haylage, a reduction from 80 percent to 60 percent moisture would reduce the weight of the load by half. With hay, a reduction to 20 percent moisture would result in one quarter of the normal load weight. Because of Newfoundland's damp climate field curing of hay is not always possible. So, several artificial drying methods have been studied. Experiments show that small hay stacks can be economically dried using a diesel-powered drying fan in the field. Further tests are underway to improve this system. Work is also being carried out on the construction of a new forage-carrying trailer, built so that the weight is spread out and the trailer is less likely to sink into the bog.

Studies on fertilizing forage in Newfoundland have recently concentrated on trace elements. Forage grown on peat bogs often lacks certain trace elements such as cobalt and copper which livestock need for proper growth. Trials have also shown that molybdenum and boron, two elements that plants need for growth, are lacking in peat soils.

Agriculture Canada scientists in Newfoundland, working in cooperation with researchers in Prince Edward Island, are now determining the amounts of copper and molybdenum that should be added to fertilizer for good plant growth and animal nutrition.

FARMBANK

FARMBANK is a computerized commodity data base maintained by Agriculture Canada's Marketing and Economics Branch. It contains approximately 1000 regional, national, and international food and agriculture data series for prices, production, stocks, consumption, imports, exports for all major grains and livestock products, as well as farm income statistics, retail prices, and general economic data.

FARMBANK data are mainly quarterly, and originate as far back as 1950. They are collected from Agriculture Canada and other Canadian, U.S., and international sources.

FARMBANK is now available on-line for a monthly fee from the Conference Board of Canada and Datacrown Inc. Prospective clients may contact their marketing representatives for more information about the data base and how to access this information.

The marketing representative for the Conference Board of Canada is Mrs. Viviane Paré; their address is 25 McArthur Ave., Vanier, Ontario, K1L 6R3. Datacrown Inc.'s representative is Mr. Jim Dunn and their mailing address in 770 Brookfield Road, Ottawa, Ontario, K1V 6J5.

AGRICULTURAL OUTLOOK CONFERENCE

This year's Agricultural Outlook Conference will be held at the Government Conference Centre in Ottawa, December 7 and 8.

The conference brings together heads of the federal and provincial departments of agriculture, and representatives from farm organizations, universities, consumer groups, agribusiness, and other government departments to discuss agricultural prospects for the coming year.

Speakers will discuss general economic trends, the world agricultural and food outlook, Canadian agricultural and food market prospects in 1982, expected farm costs and incomes, and other issues important to the agriculture and food sector.

In addition to the presentation of outlook papers, there will be individual sessions dealing with cattle and hogs, grains and oilseeds, horticultural products, poultry and eggs, dairy products, and farm costs and incomes.

Publications

International Trade and Agriculture: Theory and Policy. Edited by Jimmye S. Hillman and Andrew Schmitz, 333 pp. Westview Press, Boulder, Colorado, 1979.

Saiyed M.H. Rizvi, an economist with the Foof Markets Analysis Division, Marketing and Economics Branch, prepared this review for Canadian Farm Economics.

International trade and commercial policy has been a topic of interest to economists for a long time, especially for Canadian and American economists for whom international trade and commerce occupy an important position in the overrall economy. In Canada and in the United States, the agricultural sector has always been dependent on foreign markets, and the domestic markets in both countries have absorbed large quantities of agricultural imports. Consequently, issues of international trade have especially occupied government and private sector economists, farmers, agro-business managers, and consumer groups since the early 1970s when they experienced an abruptness in the pattern of international events which lead to a significant change from past experience. It was in this setting that a symposium on International Trade and Agriculture was held at Tucson, Arizona, in April 1977 where technical papers were contributed on major topics of agricultural trade and commerce policy by several professional agricultural economists and other trade experts. Professor Hillman and Professor Schmitz of the universities of Arizona and California brought some of these papers together in *International Trade and Agriculture: Theory and Policy.*

As a result of their remarkable efforts, the book contains papers which have been organized in four sections. The first section, consisting of three chapters, deals with the general subject of trade and agriculture. In the second section the editors have placed three papers dealing with gains from trade. These papers present a good exposition of theoretical material which is quite usual for this topic in any standard book on international trade. Section three is the largest, and contains five chapters on practical problems and issues of agricultural trade. The last section has two chapters which provide an examination of the nature and significance of problems involved in doing research in international trade and of research methodologies in international trade.

In Chapter 1, Professor Hillman provides a brief background of the international events of the early 1970s, such as the severe drought in India, the Sahel, and the U.S.S.R.; the reduced Peruvian Anchoveta catch; the two U.S. dollar devaluations; and the sharp increase in oil prices. These events led to a widespread disruption in the overall economic patterns, and especially in trade, that had prevailed since the end of the World War II. Most trading nations consequently embarked on stabilization programs and policies for their domestic economies and quickly worked out different trade strategies for making adjustments as required by these developments. As a result of these policy shifts associated with physical, political, and economic phenomena, the level as well as the content of world trade changed by the mid-1970s. Despite these drastic changes in most trading countries, the overall institutional attitude in Canada and the United States appeared to be more or less passive, and was not reflected in any massive public concern as the problems actually demanded. According to Professor Hillman, this was one of the most prominent concerns of the papers presented or discussed in the 1974 seminar on International Trade and Agriculture.

Eric Ojala opens Chapter 2 with the startling statement that world agriculture and agricultural trade are in a "state of disarry." As underlying tensions and conflicts in the area of international trade are evident, Ojala's paper outlines some of the complexities and relationships involved in the realm of trade practices and patterns. Providing an exposition of growth in agricultural trade and world economies, Ojala has examined the importance of world trade for various major regions and substantiates the analysis by giving a detailed analysis of commodity trade composition among these regions during 1974-75. Using these data, the author asserts that agricultural trade is generally characterized by a high degree of instability in terms of volume, prices, and foreign exchange earnings. This kind of instability in agricultural trade will likely handicap the planned development of many countries. As a source of economic development, Ojala argues that agricultural trade will continue to remain an important instrument for mobilizing the world's agricultural resources for the benefit of mankind.

Chapter 3, by George Ecklund, is mainly a technical description of the U.S. Trade Act of 1974 and an evaluation of its impact on the trade activities in which the United States is engaged with other countries. Ecklund indicated that this act has affected the industrial sector more than the agricultural sector. Agriculture was, however, expected to be influenced indirectly if the act turned out to be more protectionist than its predecessor's measures.

Chapter 4, by Chambers, Letiche, and Schmitz, presents traditionally-accepted theoretical models showing the nature and extent of gains from international trade.

The chapter opens by accepting the notion of the classical, neoclassical, and post-classical schools of thought that nations can gain from an expanding volume of world trade. The authors provide an excellent review of the classical theory of trade and blend it with the later neoclassical and post-World War I literature. Most of the quantitative studies in this area demonstrated that there were gains from allowing nations to trade. Despite the availability of sufficient theoretical apparatus and empirical evidence, many countries became more and more protectionist, especially on the basis of non-economic criteria. This inconsistency between the claims offerred by the theoretical models and empirical evidence, however, seems to suggest that both of these do not adequately depict reality and overemphasize the general proposition that there are always positive gains from trade. The authors suggest that several restrictive assumptions which are used in developing the theoretical models and undertaking the empirical work should be modified to bring the situation closer to reality.

Chapter 5, the most difficult and technical, is Stephen Magee's "Twenty Paradoxes In International Trade Theory." Basing the main contents of the chapter on Harry Johnsons's work, Magee presents his results in five sections: (1) the gains from trade, (2) trade and protection, (3) trade and the exercise of market power by the factors of production, (4) international trade in technology, and (5) the empirical implications of the pure theory.

Some of the chapter's conclusions are quite striking, for example: (1) introduction or expansion of international trade can make a country's welfare decline, (2) growth of an open economy can make its welfare decrease, and (3) even a prohibitive tariff may have no adverse long-run welfare effects if one of the factors of production is internationally mobile. There are 20 conclusions in all and each is theoretically exposed and well documented. All these conclusions are based on highly technical analysis which requires a good knowledge of both microeconomics and macroeconomics for clear comprehension. Both chapters 4 and 5 are accompanied by comprehensive explanatory and bibliographical notes.

Deviating from pure economic analysis, the editors have included Chapter 6, by Theodor Heidhues, to provide an analysis of the gains from trade as far as political considerations are concerned. This chapter is appropriately placed in the text to broaden the overall analysis and improve our ability to understand and explain real world phenomena. The author realizes that the complexity of the real world often defies the assumptions of classical and unclassical theories. Instead, there are highly complex structures and inconsistencies in policies and developments that depend upon fairly unique sets of circumstances which do not lend themselves to easy generalizations. Heidhues has sucessfully analyzed the issues that lead to a mixed reality of accepting an international division of labor in principle but acting against such a principle under specific conditions. The chapter begins with a brief historical overview of the developments in agricultural trade policies for two centuries, centering first on Europe and gradually widening.

To the question of why trade theory does not offer more to explain real world phenomena he seeks the answer in considering additional economic objectives, looking at major assumptions of the pure model and considering linkages with other areas of national policy. Finally, the author applies these general points to specific problems in agricultural trade policy and analyzes major constraints operating on liberal trade policies.

Recognizing the traumatic events of the 1972-77 period, Timothy Josling in Chapter 7 gives a brief account of the problems facing trading nations. This was a period of heightened uncertainty and the responsibilities of U.S. policy-makers were widened to include concern for food supplies to low-income countries. Josling discusses thoses aspects of domestic agricultural policies of particular importance to the operation of the trading system. He considers some empirical evidence on the reaction of governments, especially in the wheat market, to the period of high agricultural prices and the consequent implications of these reactions for international trade in this important commodity. The discussion is finally placed in the context of the Tokyo Round of the Multilateral Trade Negotiations and the policy choices facing major governments in the next few years.

Chapter 8, by Paul Dobbins and Garry Smeal, looks at exchange rates and U.S. agricultural exports. The authors indicate that some exchange rate changes can occur in response to price changes and are therefore to be expected. A coordinated, simultaneous movement of prices and exchange rates does little to affect trade. However, rigid exchange rates my severely affect trade if relative prices are changing or for some other reasons the exchange rate changes on agricultural trade.

Dobbins and Smeal recognize that a basic supply and demand theory is not appropriate for this kind of analysis unless qualified by the consideration of direct trade restraints, policies affecting agricultural production, and macroeconomic policies – factors which can greatly influence the relationship between agricultural trade and exchange rates. A review of existing empirical studies finds that most of them are lacking in detail, particularly those about policies and foreign competitiveness. Potential implications of several types

of market interference are therefore illustrated and discussed in this chapter. With this the authors provide a brief discussion of the interrelatedness of the exchange rates and other variables to help clarify the effects of exchange rate changes.

Chapter 9, by Alberto Valdés and Barbara Huddleston, contains analysis of the relationship between food deficits and trade prospects. The authors identify some developing countries with good prospects for using agricultural exports to finance food imports on a continuing basis, and examine the internal performance of these developing countries in relation to their export growth prospects. Valdés and Huddleston summarize their findings in one comprehensive and readily understandable table. Among the exporting countries which had good agricultural trade performance and potential were Argentina, Thailand, and Burundi. Countries with minor food import requirements included Pakistan, Brazil, Cameroon, Ethiopia, Turkey, Indonesia, and the Philippines. The authors identify a third group of countries as having sizable, regular food import requirements.

For other countries, the authors recognize that food production was highly variable and that food imports constituted a sizable share of total imports. In some countries rich in oil resources (Iraq, Nigeria, Venezuela, Libya, Algeria, et cetera), agricultural exports comprised less than 10 percent of their total exports, but with their strong balance-of-payments position these countries were able to commercially purchase all their food requirements.

In "Srategies in International Agricultural Marketing: Public vs. Private Sector," Alex McCalla looks at international marketing within a modified market structure, conduct, and performance analysis as an alternative to the use of competitive spatial-equilibrium in free trade models. The author has included in structure, conduct, and performance variables realistic factors as important prerequisites for international trade analysis.

As one of his major conclusions, McCalla points out that the majority of public participants in the export and import side seem to prefer some form of agreed-upon international market structure to the present one or a free trade situation. The author draws other pragmatic conclusions with useful policy implications.

Chapter 11, by D. Gall Johnson, is devoted to the question of food reserves and international trade policy. The author asserts that food reserves and freer international trade in agricultural products are both substitutes and complements. The primary objective of food reserves is to reduce price instability. Freer trade in agricultural products, if achieved, would also reduce price instability. It is in this sense that food reserves and freer international trade are substitutes in the quest for increased price stability in international markets and in countries whose domestic prices are closely related to international market prices. As a practical instrument, international trade policy has major impacts on the size and management of food reserves. In any trade policy, the author therefore emphasizes the importance of certain rules to manage a reserve program. So far there has been little consideration given to these rules.

The book's final two chapters relate to research and research needs in agriculture and international trade. G. Edward Schul outlines the problem areas in research and Andrew Schmitz deals in methods and techniques. Both of these important chapters should be read thoroughly by those interested in conducting research in the area of international trade.

International Trade and Agriculture: Theory and Policy is a comprehensive collection of theoretical and empirical papers on difficult issues confronting trade economists. Since most of papers analyses related to the early 1970s, the nature of their contents seems to have become too technical – involving not only economic analysis but also the tenets of political science and international affairs. It was a difficult book to review, mainly because it involved a collection of diversified concepts, analyses, and conclusions based on some of the original research being completed in the area of international trade. The book as it is may be usefully incorporated in courses for serious students in international trade and policy. All papers are well presented, coherent, and documented with detailed bibliographical notes. This book provides an excellent resource tool on important aspects of trade and commerce issues.

Energy Management for Canadian Food and Beverage Industries. 1981. Agriculture Canada. *Available from Information Services, Agriculture Canada, Ottawa, Ont., K1A 0C7.*

This new publication from Agriculture Canada describes energy-saving methods in the food and beverage processing sector and contains suggestions for saving energy in food processing plants.

The publication is a practical energy-saving checklist that manufacturers can review when looking for ways to save on their energy bills. Energy conservation opportunities are listed for boiler and power plant operations, building design and construction, electric power use, fuel management, heating, ventilating and air conditioning, heat recovery, raw product handling and cleaning, refrigeration, and weekend shutdowns.

In the case of refrigeration alone, there are 25 energy saving suggestions a processor could study.

In all, the publication lists more than 200 practical ideas for energy savings in food and beverage processing plants.

The second part of the publication lists other sources of information on energy savings and assistance available in areas such as tax incentives.

The publication was developed cooperatively by Agriculture Canada's Market Development Directorate and the Food and Beverage Sector Energy Conservation Task Force. The task force consists of representatives from the food and beverage manufacturing industry and from the federal government. This new publication will be especially useful to managers of small- and medium-sized establishments who may not be able to afford hiring a consultant to develop an energy management program.

With this book, managers will be able to develop their own programs to eliminate energy waste in their plant and increase the effective use of energy in food and beverage manufacturing.

In reply

We appreciate your letters and comments on articles in Canadian Farm Economics. *When forwarding your 'In Reply', or letter, please indicate if we may publish your comments in a subsequent issue.*

Veronica McCormick's article, "Canadian Dairy Policy – The Seventies," in our December 1980 issue was very popular. Mr. Ryoji Ishizeki, an economist with the National Research Institute of Agriculture Economics, Ministry of Agriculture, 2-2, Nishigahara, Kita-ku, Tokyo, Japan said that the article was very useful in helping him to understand the recent problems surrounding the dairy industry and the policy applied to it in Canada. He writes that "also in Japan, the surplus problem of dairy products has become serious recently." Mr. Ishizeki believes that Canadian dairy policy, especially the Market Sharing Quota plan, is a good starting point for approaching the Japanese problem.

Mr. Ishizeki asked us how much the federal government has paid in supports to the dairy industry each year in the 1970s and what its shares in supporting costs to the dairy industry are as a proportion of total agricultural support costs. We were able to provide him with tables detailing Canadian federal government expenditures on all agricultural products for 1958-79, made under the auspices of the Agricultural Stabilization Act of 1958 (and amended in 1975) which bears the responsibility of price stabilization in Canadian Agriculture. If others would like these figures please let us know.

Other readers who found the McCormick article quite useful are Dr. Ernest Mercier, a consulting agrologist, 910, ave. des Braves, Québec, P.Q., G1A 3C6; and George Morrison, who teaches high school agriculture in Morell, Prince Edward Island.

E.W. Walker, a district agriculturist with the B.C. Ministry of Agriculture and Food, 17720-57 Avenue, Surrey, B.C., V3S 4P9, writes that all of the articles in our "new-look" issue of February 1980 were very useful. He went on to say that the bottom line conclusions of the Lovering and McIsaac and the Dyer *et al.* articles were excellent.

J.A. Boan, a teacher at the University of Regina; and Mr. James Rigg, 5780A Eldridge Ave., Cote St-Luc, Québec, H4W 2E4, both found the McClatchy and Abrahamse article, "The Role of Farm Consolidation in Canadian Rural Population Change," in our April-June issue quite useful.

IN REPLY TO AUTHORS AND EDITORS REGARDING VOL. 16, NO. 5, OCTOBER 1981

CANADIAN FARM ECONOMICS

I have read	*and on a scale of 0 to 10, found it* *not useful*		*very useful*
J.A. Dyer, D.G. Warner, and R.B. Stewart	0	5	10
S. Al Hassan, K.B. McRae, H.W. Hulan, and F.G. Proudfoot	0	5	10
P. Blakely	0	5	10
Economic indicators	0	5	10
Notes	0	5	10
Publications	0	5	10
In reply	0	5	10

Comments on (name of section of article)

Do you have any other suggestions or questions on the contents of this issue?

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32 Publications

CANADIAN FARM ECONOMICS (CFE) is published bimonthly by Communications Branch, Agriculture Canada, Sir John Carling Building, Ottawa, and is based on material prepared by members of the Regional Development and International Affairs Branch and the Marketing and Economics Branch.

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HON. EUGENE WHELAN, MINISTER
GAÉTAN LUSSIER, DEPUTY MINISTER

Economics of short-term energy conservation adjustments on prairie grain farms

The supply and price of gasoline and diesel fuel have been of increasing concern to the Canadian farm sector because of price rises by the Oil Producing and Exporting Countries (OPEC) and the continuing political instability in Middle East supply countries. The farm sector, although it consumes only 3 percent of all energy used by the Canadian economy, is an important user of diesel fuel (11 percent) and gasoline (7 percent). Farmers in Manitoba, Alberta, and Saskatchewan incurred 13, 29, and 25 percent of the total farm expenditures for fuel in 1980.

This article examines the economic feasibility of making selected adjustments in production practices as a means of conserving energy, especially liquid fuels, on selected types of prairie grain farms.

K.D. Russell and H.T.M. Colwell

INTRODUCTION

There are several ways in which a farm manager could reduce fuel use. Fuel waste can be eliminated through timely equipment maintenance and avoidance of long periods of engine idle time and unnecessary machinery operation.

Another way to decrease fuel use is to increase energy efficiency in performing specific operations. This could be accomplished by switching from gasoline to more fuel efficient diesel engines, by using more fuel efficient machinery, and by properly matching tractor power to machinery size.

A third approach is to change the process or jobs required for producing a specific commodity, such as substituting herbicides for summer fallow tilling or by eliminating or combining some operations.

A fourth way to reduce fuel use is to plant crops which require less petroleum to produce. On a prairie grain farm, for example, one could alter the proportion of crops to summer fallow, or alter the mix of crops produced, or both.

This article concentrates on adjustments which alter the process required for producing a specific commodity, change the land use mix, or both. Options considered are those which a farm manager can adopt within one or two growing seasons without significantly altering his machinery complement or land base. The potential for reducing energy waste or increasing energy efficiency is also discussed.

METHODOLOGY

Representative dryland farm situations were defined for three key soil zones with emphasis on establishing current land use, cropping patterns, and energy use. A whole farm simulation model was used to establish a resource base and the financial status of the representative farms. Deviations in resource use and in the financial status of the representative farms caused by adopting selected energy conservation adjustments were monitored through the model.

Representative Farms

The cultivated prairie area suitable for wheat production consists of seven major soil groups. Representative farms were created for each of the three chernozemic soil groups only. These three groups include two-thirds of all prairie grain farms and three-quarters of prairie wheat production.

Black chernozemic soils, on which 50 percent of prairie wheat is produced, contain 37 percent of prairie farms and account for approximately one-third of the total land area (Figure 1) that is suited or well suited to wheat production (Acton *et al.* 1980). Farms in brown soil zones account for 14 percent and farms in dark brown soil zones comprise 18 percent of all farms in the Prairie Provinces. The brown and dark brown soils occupy an area equal to that of the black soils but their total wheat production is only half as much.

Dr. Dale Russell was until recently a research economist with the Regional Development and International Affairs Branch, Lethbridge, Alberta.

Dr. Max Colwell is Head, Energy Research, Production Development Policy Division, Regional Development and International Affairs Branch, Ottawa.

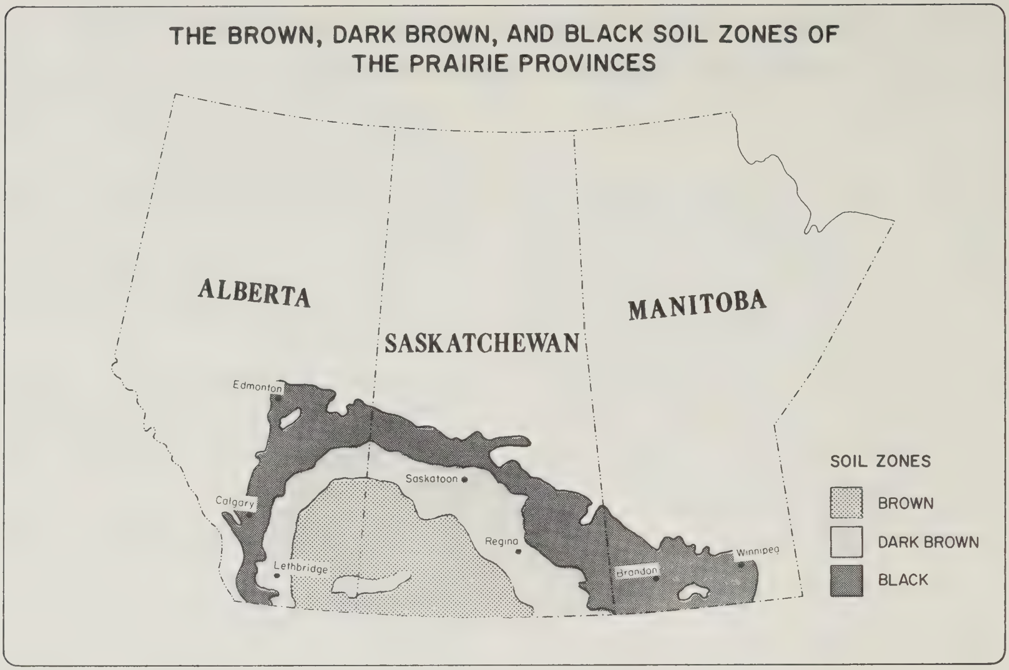

Figure 1

The Brown Soil Farm

The brown soil zone is in the semiarid, short grass, prairie section of Saskatchewan and Alberta. The average annual precipitation in the area is about 30 cm, with the yearly total varying from 15-66 cm. Adequate moisture is the main limiting factor to crop growth and summer fallowing is an integral part of a soil moisture management program.[1] Census of Agriculture data for 1976 indicate that 43 percent of the cropped area was in fallow (Figure 2).

A one-half crop and one-half fallow rotation is the traditional cropping pattern in this soil zone and has been assumed for the representative farm (Table 1).

On the brown soil zone representative farm, 85, 10, and 5 percent of the planted area were assigned to wheat, barley, and rapeseed production. These subdivisions agree with the recorded areas for wheat and other cereals in the 1976 Census data, but slightly exceed the recorded proportion of cropped area planted to oilseeds (Figure 3).

A farm size of 518 ha was assumed. Land in the Prairies is surveyed by section (259 ha each) and the chosen farm size includes two sections. It also falls within the most populous size groupings as recorded in the 1976 Census of Agriculture (Figure 4). Four hundred and eighty-six hectares of the chosen land areas on the representative farm were allocated for cropland and 32 ha for building site, pasture, headlands, waste, and so forth.

The Dark Brown Soil Farm

The dark brown soils are in an area that is slightly less arid than the brown soil zone. Annual precipitation averages about 35 cm, but varies widely from year to year. Adequate soil moisture is the limiting factor to crop growth but is often not as critical as for the brown soil zone and the land is cropped more intensively. Fallow accounted for 39 percent of the total crop area in 1976 (Figure 2). A cropping program of one-third fallow and two-thirds crop was assumed for the representative farm in the dark brown soil zone.

Of the area devoted to cereals and oilseeds in 1976, 76 percent was planted to wheat. Barley accounted for a further 15 percent (Figure 3). On the representative farm, 75, 15, and 10 percent of the planted land were assigned to wheat, barley, and rapeseed (Table 1).

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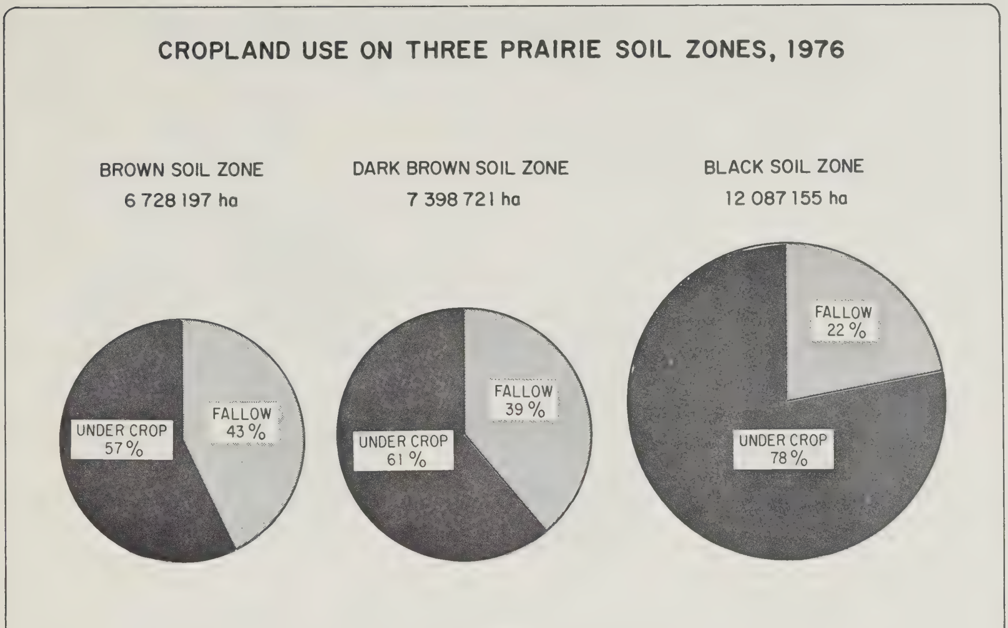
[1] Research indicates that summer fallowing is a poor method of soil moisture conservation; however, since it is still a common practice, it has been included in this analysis.



Source: *1976 Census of Agriculture. Saskatchewan, Alberta, and Manitoba.* Statistics Canada.

Figure 2

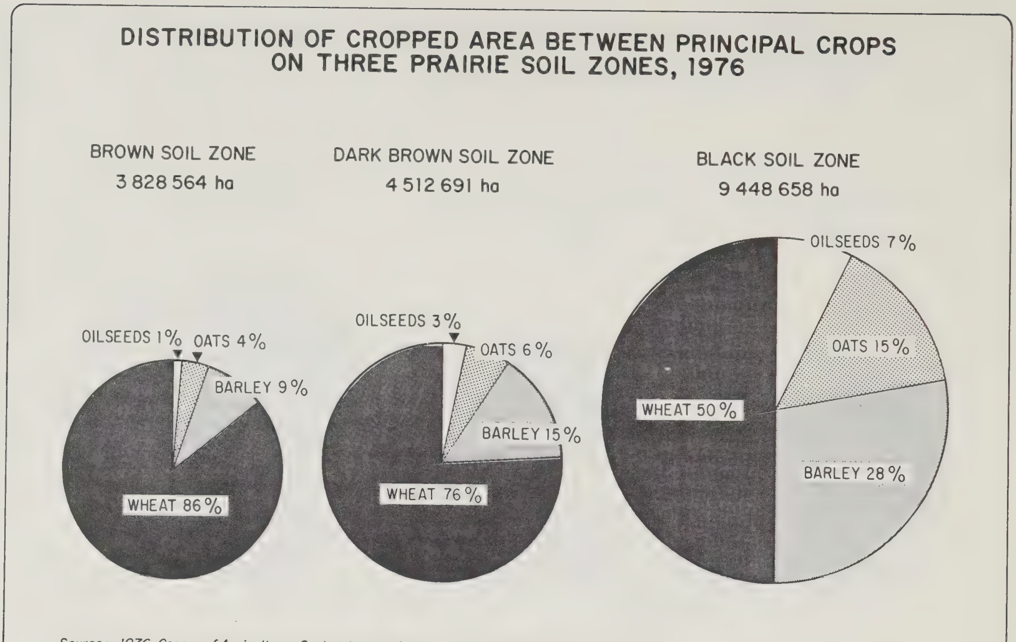
TABLE 1. REPRESENTATIVE FARMS FOR EACH SOIL ZONE, 1980

Component	Soil Zone: Brown	Dark Brown	Black
Cultivated area (ha)	486	365	251
Rotation (fallow-crop)	1/2 – 1/2	1/3 – 2/3	1/4 – 3/4
Wheat (%)	85	75	50
Barley (%)	10	15	30
Rapeseed (%)	5	10	20
Net income ($)	63 797	57 922	48 451
Crop production (t)	449	433	384
Labor (hr)	1 029	1 238	1 218
Labor (hr/t of production)	2.29	2.86	3.17
Total fuel use (L)	13 556	15 429	11 528
Fuel use (L/t of production)	30	36	30
Motor fuel expenses for field operations ($)	2 950	3 342	2 501
Fertilizer expenses ($)	3 792	7 224	7 467
Chemical expenses ($)	1 410	1 716	1 674

The most common farm size on the dark brown soil zone in 1976 was 308-453 ha (Figure 4). This category represented 20 percent of the farms in that soil zone. One and one-half sections were chosen as the land base for the dark brown soil zone representative farm. Three hundred and sixty-five hectares were allocated for cropland and 24 ha for the building site, et cetera.

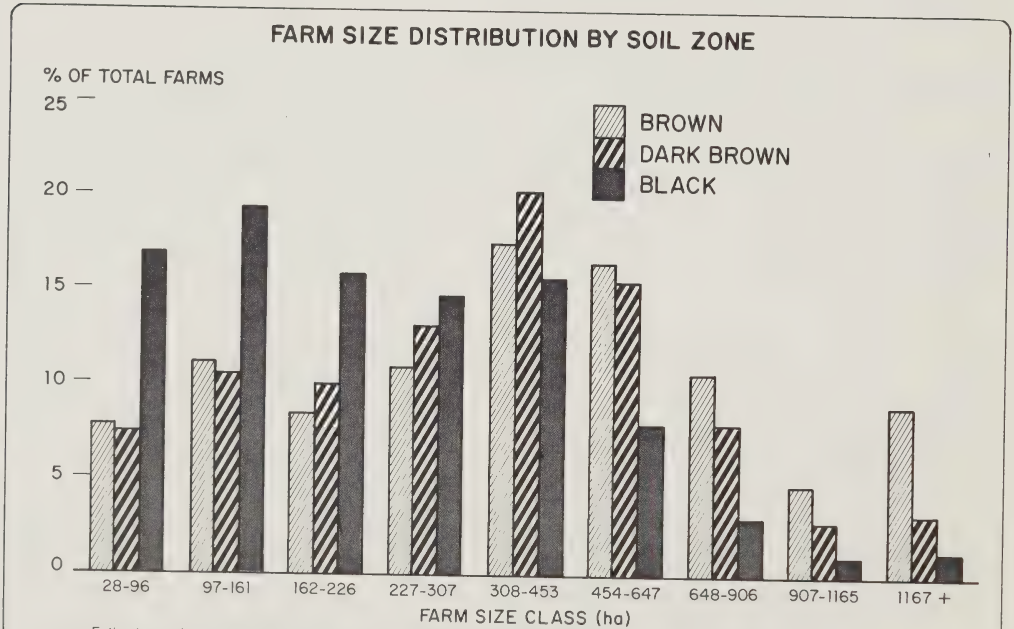
The Black Soil Farm

The black soils are found in areas with a sub-humid climate, in general, the ‘parkland’ portion of the Prairie Provinces. Annual rainfall varies from 38 to 46 cm across the soil zone and is usually not a limiting factor to crop growth. Summer fallowing is primarily practiced for weed control. In 1976, 22 percent of the total cropland area was fallow (Figure 2). A one-quarter fallow to three-quarter cropping program was assigned to the black soil zone representative farm.



Source: *1976 Census of Agriculture. Saskatchewan, Alberta, and Manitoba.* Statistics Canada.

Figure 3



Estimates are based on weighted averages of census divisions across the soil zones.
Source: *1976 Census of Agriculture, Saskatchewan, Alberta, and Manitoba.* Statistics Canada.

Figure 4

Wheat accounted for 50 percent of the area planted in 1976 to major crops in this soil zone (Figure 3). Barley, oats, and oilseeds comprised a further 28, 15, and 7 percent. Therefore, 50, 30, and 20 percent of the cropped area on the representative black soil zone farm were assigned to wheat, barley, and rapeseed (Table 1).

A one-section farm (259 ha) was chosen as the land base for the black soil zone representative farm. This representative farm was larger than the most common farm size of 97 to 161 ha, but because of the skewed distribution of farm sizes in this soil zone (Figure 4), it corresponds with the average farm size in the 1976 Census data. Eight hectares of the land base were allocated to the building site, waste land, and so forth.

Resource Use

The quantity of resources used, the costs, and the incomes have been calculated for 1980 for each representative farm situation using the simulation model outlined below and 1980 unit prices (outlined in the appendix) for various crop inputs and grain prices. The data on resource use and costs (Table 1) represent a base situation. The impacts of energy conservation possibilities were measured as deviations from this base situation.

Calculated annual fuel consumption was highest for the dark brown soil farm at 15 429 L (Table 1), compared with 13 556 L and 11 528 L for the typical brown and black soil zone farms. The annual cost of fuel consumption was estimated to range from $2501 for the typical black soil zone farm to $3342 for the dark brown soil zone farm.

Annual fuel expenditures calculated for the representative farms were compared with fuel expenditures recorded in a probability sample of Saskatchewan grain farms (Sorboe 1981). Fuel and oil expenses for the representative farms were consistent with those of the Saskatchewan farm sample (Table 2). Fuel expenditures calculated for the brown and black soil farms were below these in the farm sample survey, while the converse was true for the dark brown soils.

Differences in fuel costs could be due to several factors. Fuel and oil expenditures for the representative farms related primarily to fuel used in field operations. Overhead motor fuel consumption was not included. Farms in the sample survey used approximately 10 percent of their improved land for crops such as hay and pasture, which tend to be less energy intensive than grain production. It was assumed that all of the non-fallow improved land on the representative farms was planted to wheat, barley, and oilseeds.

Fertilizer expenses were consistently higher for all representative farms than for the average of the Saskatchewan farm sample. The simulation model used to identify fertilizer expenditures for each representative farm calculates the highest fertilizer application level that is economically feasible at the chosen fertilizer and grain prices. The economically optimal application rate is based on relationships between fertilizer applications and yields established from experimental studies in Western Canada. In practice, the fertilizer levels used could be lower for several reasons, including slightly different soil type, the farm manager's aversion to risk, lack of capital for fertilizer expenditures and a lack of knowledge of crop response to different fertilizer levels. Therefore, the model establishes the theoretical maximum level of fertilizer expenditures, while the farm sample reflects what is happening in practice.

The Simulation Model

The Zentner, Sonntag, and Lee (1978) dryland crop simulation model was used to simulate the cropping processes for each of the representative farms. The model simulated the crop production processes for conditions unique to each farm situation, including input costs, the operator's managerial abilities, soil productiveness, and resource availability.

The model was used in this study to generate budget comparisons among the various management technologies.[2] Energy efficiencies in performing the specific crop production processes are internal to the model and are fixed throughout the analysis. Crop input costs were based on 1980 crop year data (see appendix).

The model monitors environmental conditions, cash flows, and resource use throughout the production process. The following items were examined for this study: total production; fuel use and expenses of gasoline and diesel used for field operations; net income earned by the farm after all cash costs are paid, including variable crop input costs, property taxes, income taxes, machinery repair, and loan payments. Costs do not include a return on capital investment or an allowance for depreciation on the fixed assets; labor, including the operator's and hired labor involved in crop production activities; fertilizer use and expenses of nitrogen and phosphorus; and chemical expenses of herbicides and pesticides for insect and weed control.

[2] In this study a budget approach was used rather than an optimization procedure. A budget approach's objective is to identify the effect of a single change on farm output, expenses, and income, assuming that all other aspects of the farm operation stay the same. An optimization approach's aim is to identify the farm operating plan which will maximize profits or minimize costs. In this approach many factors can simultaneously change.

TABLE 2. RESOURCE USE COMPARISON

	Fuel and Oil		Fertilizer	
Soil Type	Representative Farm	Sask. Probability Sample[a]	Representative Farm	Sask. Probability Sample
		$/ha		
Brown	6.08	7.27	7.81	2.03
Dark brown	9.17	7.19	19.85	8.43
Black	9.96	12.95	29.77	19.23

[a]Adapted from Sorboe, M.M., *Economics of Crop and Livestock Production in Saskatchewan, 1977, 1978.* Agriculture Canada Working Paper, Agriculture Canada, 1981.

(Input prices were updated to 1980, based on the *Petroleum Price Index for 1978, 1979, and 1980.* Source: Statistics Canada, Catalogue No. 62-004 Quarterly.)

TABLE 3. BASIC CROP ROTATIONS ASSUMED FOR THE BROWN SOIL ZONE

	Crop Rotation		
Component	1/2 – 1/2	1/3 – 2/3	Continuous Crop
Total fuel use (% of base)	100	115	146
Fuel use (L/t of production)	30	32	38
Hours of labor (% of base)	100	116	148
Labor (hr/t of production)	2.29	2.46	2.90
Total production (% of base)	100	108	117
Net income (% of base)	100	102	83

RESULTS

Adjusting the Land Use Mix

The land use mix can be adjusted by altering the proportion of summer fallow in the crop rotation, the proportion of the land seeded in any one year to a particular crop (for example, wheat), or both.

Altering Crop Rotation

Summer fallowing requires heavy fuel-intensive machinery throughout the summer. Farmers in the various soil zones have flexibility in the proportion of their land which is left in summer fallow in any particular year. Three rotations were evaluated for each soil zone. The first comprised 50 percent summer fallow and 50 percent under crops called the 1/2 – 1/2 rotation in Tables 3 to 5. The second rotation considered for the brown and dark brown soil zones was called the 1/3 – 2/3 and included 33 percent of the land in summer fallow. The assumed basic rotation on the representative farm for the black soil zones was the 1/4 – 3/4 as outlined earlier. This remains the intermediate intensity rotation. The third and most intensive rotation, the continuous crop rotation, assumes that summer fallow is eliminated.

The effects of altering crop rotations are given in Table 3 for the brown zone, Table 4 for the dark brown zone, and Table 5 for the black soil zone. Total quantities of fuel and labor required per farm increased for each soil zone as the proportion of summer fallow included in the rotation declined. The most intensive rotation, continuous cropping, required 46, 16, and 7 percent more fuel than the base rotations for the brown, dark brown, and black soil zones. Increased cropping intensity involves extra fuel use in spring and fall operations. The amount of fuel consumed by summer fallow operations appears to be smaller than that used by rotations involving less summer fallow. Total fuel requirements were 8 percent and 7 percent less for the 1/2 – 1/2 rotations on the dark brown and black soil zones, compared with the standard rotations assumed in the base case.

The quantity of grains available for sale, measured as total production in this study, increased as the proportion of summer fallow land declined. Production as a percentage of the base situation increased 17, 24, and 27 percent for continuous crop rotations on the brown, dark brown, and black soil zones.

TABLE 4. BASIC CROP ROTATIONS ASSUMED FOR THE DARK BROWN SOIL ZONE

Component	Crop Rotation 1/2 – 1/2	1/3 – 2/3	Continuous Crop
Total fuel use (% of base)	92	100	116
Fuel use (L/t of production)	37	36	32
Hours of labor (% of base)	90	100	121
Labor (hr/t of production)	2.91	2.87	2.72
Total production (% of base)	88	100	127
Net income (% of base)	88	100	120

TABLE 5. BASIC CROP ROTATIONS ASSUMED FOR THE BLACK SOIL ZONE

Component	Crop Rotation 1/2 – 1/2	1/4 – 3/4	Continuous Crop
Total fuel use (% of base)	93	100	107
Fuel use (L/t of production)	36	30	26
Hours of labor (% of base)	93	100	108
Labor (hr/t of production)	3.46	3.18	2.77
Total production (% of base)	78	100	124
Net income (% of base)	77	100	119

TABLE 6. AVERAGE FERTILIZER USE FOR THE CROPPED AREA OF THE CROPPING ROTATIONS FOR THREE SOIL ZONES

Crop Rotation	Brown N	Brown P	Brown Production	Dark Brown N	Dark Brown P	Dark Brown Production	Black N	Black P	Black Production
	-kg/ha-		-t/ha-	-kg/ha-		-t/ha-	-kg/ha-		-t/ha-
1/2 – 1/2	1	28	1.84	8	25	2.11	9	31	2.37
1/3 – 2/3	17	26	1.34	26	24	1.77			
1/4 – 3/4							41	29	2.04
Continuous	34	25	1.08	43	24	1.50	57	28	1.88

Changing to a less intensive rotation for the representative farms reduced total fuel use and production per farm. An 8 percent fuel saving was achieved in the dark brown representative farm situation by moving from a 1/3 – 2/3 rotation to a 1/2 – 1/2 rotation, but grain production fell 12 percent (Table 4). The production decline for the black soil zone was substantially larger at 22 percent and was accompanied by a 7 percent decline in fuel consumption.

Fuel productivity, calculated as liters per tonne of grain produced, combines the effects of reduced fuel consumption and grain production. On the brown soil zone representative farm, fuel use per tonne of production increased from 30 L to 38 L as the rotation changed from the 1/2 – 1/2 rotation to continuous crop production (Table 3). Little potential exists to reduce fuel use in the brown soil zone by rotation adjustments because the 1/2 – 1/2 rotation requires the least amount of fuel per tonne of production and total fuel used per farm (Table 3).

Fuel productivity improved by 4 L/t of grain produced as the proportion of summer fallow was reduced on the dark brown and black soil zone farms (Tables 4 and 5). The primary reason for the increased fuel productivity in these two representative farms was the relatively small decline in crop yield as the crop rotation was changed from the base situation to continuous crop (Table 6). In the brown soil zone, rotation intensification was accompanied by large declines in crop yields.

Altering the crop rotation on prairie grain farms influences fertilizer requirements in addition to fuel and labor inputs. Nitrogen fertilizer application rates increased as cropping intensity increased (Table 6).

TABLE 7. CROP MIX ALTERED TO WHEAT PRODUCTION ON ALL THE CROPPED ACREAGE FOR EACH SOIL ZONE

Component	Soil Zone		
	Brown	Dark Brown	Black
Total fuel use (% of base)	100	100	100
Fuel use (L/t of production)	30	35	29
Hours of labor (% of base)	100	100	100
Labor (hr/t of production)	2.29	2.78	2.75
Total production (% of base)	100	103	104
Net income (% of base)	108	114	131

Summer fallow enhances the availability of nitrogen in the soil. As land is more intensively cropped, more nitrogen fertilizer must be applied to maintain economically optimum yields.

Phosphorus fertilizer use decreased slightly as cropping intensity increased. Summer fallowing does not affect the buildup of phosphorus in the soil. As the land is cropped more intensively there is less moisture in the soil and the yield response to phosphorus decreases. The economically optimum level of phosphorus will decrease as cropping intensity increases.

Net income increased on the dark brown and black soil zone farms as the rotation became more intensive. In both cases, continuous crop rotations required the use of more fuel, which resulted in higher levels of production per farm and fuel productivity per tonne of grain production. On the dark brown farm, net income was increased 20 percent by moving to continuous crop from the base situation (Table 4). A similar change in rotation on the black soil zone resulted in a 19 percent increase in net income (Table 5). The opposite occurred on the brown soil zone farm where intensification from a 1/2 – 1/2 rotation to a 1/3 – 2/3 rotation caused a 2 percent income increase, but a change to continuous cropping reduced net income 17 percent (Table 3).

Altering the Crop Mix

It was assumed that raising a particular crop may be more energy efficient than producing other crops in the crop mix. The crop mix for each of the representative farms was altered to 100 percent of the cropped area in wheat production. The base crop summer fallow ratios for each soil zone were not changed (Table 7).

Total fuel and labor use were unaffected by a change in crop mix. Total production rose 3 percent in the dark brown and 4 percent in the black soil zone. The production increase resulted in a slight rise in the productivity per unit of output for labor and fuel. Net income for each representative farm increased primarily because of the relatively higher sales value for wheat compared with other production possibilities. If a particular crop is more adapted to a region, then concentration of that crop in the crop mix will decrease the fuel and labor requirement per unit of output.

Adjusting Crop Production Techniques

Eliminating Swathing Operations

Swathing is common in all three soil zones, and is practised for several reasons. Wind is very common in the brown and dark brown soil zones and will shell-out a ripe crop of standing grain. Swathing anchors the grain heads so that they cannot be knocked about. August hailstorms and heavy rains are also a concern in certain districts. Swathing reduces the risk of crop damage in such cases since the grain on the bottom of a swath is more protected during a storm. Swathing is often advantageous where early frost is a danger since it hastens ripening. Uneven terrain in fields often results in uneven ripening of the crop. Swathing is considered a must in this case since it reduces the shell-out risk of the ripe crop and hastens the ripening of the unripe portion.

Swathing is generally regarded as insurance. Yields may be unaffected by eliminating swathing and one field operation can be saved; or yields may be severely affected (70 percent reductions), making one extra field operation a small price to pay. It is generally assumed that yields will be reduced 8 percent if swathing is eliminated. This estimate varies by region and year.

The results of eliminating swathing, which assumes a yield reduction of 8 percent, are outlined in Table 8. Total fuel use declined for the non-swathing option. The brown soil zone farm is not as intensively cropped and its total fuel use declined 6 percent compared with an 8 percent decline for each of the other two situations. The average quantity of fuel required per tonne of grain produced did not change since the assumed yield reduction of 8 percent corresponded with the reduction in total fuel requirements. Net incomes under the given assumptions were reduced 12 percent for the representative farm on the black soil zone and 13 percent for each of the remaining two soil zones.

TABLE 8. RESULTS OF NON-SWATHING (Given an 8 percent reduction in yields)

Component	Soil Zone Brown	Dark Brown	Black
Total fuel use (% of base)	94	92	92
Fuel use (L/t of production)	31	36	30
Hours of labor (% of base)	92	90	90
Labor (hr/t of production)	2.28	2.82	3.11
Total production (% of base)	92	92	92
Net income (% of base)	87	87	88

Chemical Weed Control Technology

An agricultural technology that has recently entered Western Canadian agriculture is the concept of minimum or zero tillage cropping, which replaces or partly replaces tillage operations with appropriate herbicide application.

Minimum or zero tillage is a relatively new concept and grower experience in using it has been limited. Herbicide selection and application is critical to adequately control weeds. Herbicides not in common use by western farmers are needed to control the broad spectrum of weeds present in summer fallow and special care is often required to effectively use these particular herbicides. In addition, they are often more expensive than the broadleaf herbicides in common use. Consequently, minimum or zero tillage practices are still being experimented with and are probably not suitable practices for all crop farmers or for all soil types and crops.

Zero tillage with a one-half crop to one-half fallow rotation on brown soils at Lethbridge, Alberta, has resulted in average yield increases of 6 percent (Zentner and Lindwall 1978). Yield increases are the result of water and possibly soil nutrient conservation. Conservation of these elements is dependent on the ability of the herbicide program to control weeds with minimum soil disturbance. The analyses reported in Tables 9 and 10 assumed that yields equalled those of normal tillage practices. This assumption may be optimistic, given farmers' limited experience with chemical fallow programs.

One major advantage of minimum tillage is the reduction of machine hours and fuel use. These savings, however, are partly offset by increased chemical costs. Chemical costs range from $5/ha for limited herbicide programs to $85/ha and more for comprehensive herbicide programs.

Two chemical programs were analyzed for this report. One program used a limited chemical program in which one application of Fallow-Guard was used to replace two tillage operations for fallow. (Fallow-Guard is a relatively inexpensive chemical and was assumed to cost $5/ha.)

Table 5 contains the results of the limited chemical program. Total resource savings varied by soil zone. The greatest fuel savings of 18 percent is in the brown soil zone since it has the largest proportion of summer fallow to crop acreage. Total production did not increase, thus the productivity of labor and fuel rose from that of the representative farm. Net incomes in all three representative situations did not change because the extra costs of the chemical were balanced by the labor and fuel cost savings.

The second minimum tillage program reduced tillage operations to one on the dark brown and brown soil farms and two on the black soil farm. A herbicide program replaced all post-harvest and pre-seed tillage operations. Stubbled-in crops were planted with a discer and packers rather than the conventional double disc or hoe drill.[3] Studies have shown that the use of the discer to seed stubble land may increase yields for all the crop zones. Use of the discer in the brown soil zone is limited, while its use in the black soil zone is more common.

Chemicals used for the more intensive herbicide program include Paraquat and Round-Up, which are very expensive compared with the more conventional herbicides. Chemical costs assigned to fallow operations were $62/ha for the brown soil zone, $74/ha for the dark brown zone, and $86/ha for the black soil zone (Table 10). These cost estimates are conservative and will vary by the types of weed present.

Minimum tillage is an effective method of reducing total fuel use and increasing fuel productivity for crop production. Reductions in total fuel use ranged from 26 – 37 percent (Table 10). Hours of crop labor were reduced 15 percent for the brown soil farm and 28 percent for the dark brown soil farm. The dark brown soil farm had a greater reduction in fuel and labor use than the black soil because the dark brown soil farm had slightly more fallow and the black soil farm had an extra tillage operation on its fallow. The brown soil farm had the greatest fuel and labor savings because it had a higher proportion of summer fallow than the other farms.

[3] Stubbled-in crops are those which follow a crop from a previous year on the same land on which no post-harvest or preseeding tillage has been performed.

TABLE 9. LIMITED HERBICIDE PROGRAM TO REPLACE TWO TILLAGE OPERATIONS ON FALLOW

	Soil Zone		
Component	Brown	Dark Brown	Black
Total fuel use (% of base)	82	94	94
Fuel use (L/t of production)	25	34	28
Hours of labor (% of base)	88	95	96
Labor (hr/t of production)	2.02	2.71	3.05
Total production (% of base)	100	100	100
Net income (% of base)	100	100	100

TABLE 10. MINIMUM TILLAGE PROGRAM

	Soil Zone		
Component	Brown	Dark Brown	Black
Total fuel use (% of base)	74	63	64
Fuel use (L/t of production)	22	23	19
Hours of labor (% of base)	85	72	75
Labor (hr/t of production)	1.95	2.06	2.39
Total production (% of base)	100	100	100
Net income (% of base)	77	84	91

Net incomes for all three of the representative farms declined substantially because fuel and labor were being replaced by much more expensive chemicals. Estimated reductions in net income varied from a low of 9 percent on the black soil zone farm to 23 percent on the brown soil zone farm.

DISCUSSION AND CONCLUSIONS

This paper evaluated the economic feasibility of selected energy conservation strategies relating to changes in land use or production technology on prairie grain farms, using 1980 prices for inputs and grains.

The study results indicate that energy conservation measures such as increasing the proportion of summer fallow in the rotation or of substituting chemical herbicides for mechanical weed control could reduce the absolute quantities of fuel required on prairie grain farms. However, the reductions in fuel use are less than 10 percent in most cases and are accompanied in some adjustments by yield reductions which lead to lower fuel productivity, measured as liters of fuel per tonne of grain produced. In addition, some practices, for example, minimum tillage, are relatively new and actual experience with them is limited.

The relationship existing in 1980 between prices of direct energy inputs, such as fuel; indirect energy inputs, such as fertilizers and chemicals; and crops, such as wheat, barley, and oilseeds, determined the estimated impact of energy conservation measures on the prairie farmer's income. These price relationships could, of course, change and affect the outcomes.

With the relative prices and crop yield assumptions used in this study, adoption of production adjustments which could reduce the prairie farmer's total liquid fuel use, for example, more summer fallow or eliminating swathing and adopting a minimum tillage program, would probably also reduce the farmer's net income. The strategies examined in this study resulted in income declines of up to 23 percent. The cost of fuel required per tonne of grain produced is relatively small ($9 to $12). However, the use of a limited herbicide program to replace two tillage operations on fallow, which in this study had a negligible income effect, but reduced farm liquid fuel requirements 6 to 18 percent, depending on soil type, warrants further investigation.

The results of this study suggest that potential exists for Western Canadian grain farmers to undertake economic energy conservation aimed at increasing the productivity of liquid fuel use. Adjusting the crop rotation to reduce the area devoted to summer fallow involved increased use of fuels and fertilizers, but the resulting increase in the quantity of grains available for sale from the dark brown and black soil zone farms was sufficient to increase the physical fuel productivity and the net income per farm.

The results also indicate that at current energy prices, there is limited scope for profitable reductions in fuel use through adjusting rotations and the production technology of cereals and oilseeds in Western Canada. However, greater opportunities may exist to economize in liquid fuel use for non-field operations, including heating farm buildings and operating farm cars and

More fuel-efficient diesel engines can be used to conserve energy.

trucks. A recent report (Jensen Engineering 1981) estimated that more than 50 percent of the gasoline used by farmers in Alberta is consumed in non-field operations and concluded that overall energy reductions of 15 - 35 percent are feasible on a sample of farms while maintaining current production levels and family lifestyles.

Increasing productivity by using more fertilizer appears to have substantial potential on prairie dryland grain farms. Fertilizer expenditures recorded on a sample of Saskatchewan farms were approximately half of those calculated for the representative study farms. The latter values were based on relationships between crop yields and fertilizer input established under experimental conditions in Western Canada.

Fuel use for machine operations is related to the cropped areas. Increasing yields through fertilization will result in reduced liquid fuel use per unit of output.

The National Energy Program introduced by the Government of Canada in October 1980 and the September 1981 energy pricing and taxation agreement with Alberta means higher consumer prices for liquid fuels. Such increases may stimulate conservation of liquid fuels and promote substitution of oil by relatively less expensive fuel sources, such as natural gas, propane, and electricity, particularly in non-mobile applications.

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Criteria for drought in spring forage growth

The criteria for defining drought areas for beef producers are based on soil moisture reserves, perennial forage growth rates, and their probabilities of occurrence. A graphical method for quantifying these criteria is described and demonstrated here. The set of graphs used in the method was derived from computer simulation of forage growth and soil moisture reserves. The analysis shows that there are still significant differences in the risk of drought in different regions and soils, even when these expectations were expressed as a percent of the average at each site. The results of this analysis should be of interest to developers of drought assistance programs and to policymakers.

J.A. Dyer, D.B. Warner, and R.B. Stewart

INTRODUCTION

This paper describes a probability analysis for drought periods in the Prairie Provinces. It was undertaken to assist in the development of measures for helping western beef producers endure drought. This article and drought experts at the Atmospheric Environment Service in Toronto (McKay 1981) recognize that drought is a relative term, and must be defined by its impact on each sector of our society. Thus we deal specifically with long-term effects on forage and livestock production. The specific issues are the availability of early spring pasture by May 31 and the potential at that date for a hay crop later in the season.

For this analysis a drought year is defined as any year when the estimated soil moisture reserves fall below a selected threshold level. To select these threshold levels both estimated forage yields associated with the soil moisture reserves and the corresponding probabilities of moisture and yield estimates are used.

A necessary task in studying drought is to map drought stricken areas. A scheme for preparing drought maps was described in the previous issue of *Canadian Farm Economics* (Dyer *et al.* 1981). This scheme calls for selected soil moisture levels for different soil types. It requires that each soil type threshold be constant throughout the area being mapped. Development of a method for objectively selecting threshold soil moisture levels is an important aspect of this paper.

Making the threshold level selection is a difficult and critical task. The outcome can affect large numbers of farmers, as changes in criteria for drought result in large differences in the area assumed to be suffering from it. Ideally, the impact of drought should be defined in terms of the economic losses of forage yield reductions. Economic impacts, however, are difficult to quantify. The interaction between drought losses and many management decisions made by beef producers, for example, is unclear. The monetary value and the quantity of forage crop losses are also difficult to assess.

Probability estimates offer an alternative to economic analysis. If the probabilities of drought (according to chosen criteria) are high, then drought assistance will be

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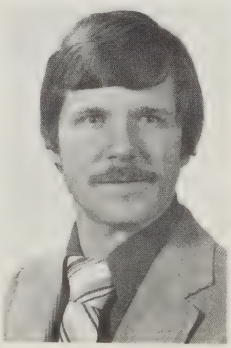

given often. This could not only reward poor management, but also encourage beef production in areas which are too drought prone to support livestock production. And low probabilities could lead to drought criteria which exclude areas occasionally stricken by drought and needing assistance in extreme years.

The impact of drought varies by region. For instance, in predominantly sandy areas, crops are much more vulnerable to drought because of the small capacity of these soils to store moisture. And the same drought intensity can be expected more often on a sandy soil than on a clay soil. The degree of added stress to crops grown on a more drought prone soil is also an important consideration. Climate also varies considerably throughout the prairies. For example, the Kindersley area normally has less rainfall than other parts of Saskatchewan (Atmospheric Environment Service 1975).

Drought must therefore be defined for each set of soil and climatic conditions. In most years on the prairies, forage crops suffer some degree of yield reduction because of moisture stress. It is difficult to objectively select threshold conditions as criteria for drought, even when these criteria are based on physical principles. The selection of criteria for drought conditions according to chances for occurrence of these conditions in future years is a solution to the relative nature of drought. However, the probabilities of drought also vary regionally. Therefore, to select soil moisture criteria for drought which are constant for the drought area, a special procedure for predicting the regional differences in probabilities is required.

METHODOLOGY

For this study a probability analysis was carried out based on historical weather records. An effective comparison of the impact of weather and different soils at a variety of sites could only be done by a computer simulation procedure, particularly for perennial forages (e.g., grasses) because there are so many ways of harvesting them (including haying and pasturing). Also, there are so many factors other than drought which can affect forage yields, that field evaluation of yields that are really satisfactory for drought monitoring is impossible. Thus a forage growth simulation model developed by Selirio and Brown (1979) was used to generate forage growth estimates by May 31 which reflect reductions in yield due to moisture shortage.

The Selirio and Brown model computes theoretical maximum growth by heat accumulation. As the season progresses, a sigmoid curve describes the increasing rate of biomass accumulation. Theoretical daily growth increments are converted to actual daily growth by multiplying the theoretical increments by the relative soil water reserves.

Model estimates of forage production were calculated as a percentage of the total possible growth under well watered conditions, instead of in actual tonnes per hectare. This was achieved by dividing the actual accumulated growth estimates by the theoretical maximum accumulated growth. This means that if the crop is never stressed by water shortage the maximum growth by May 31 would be 1.0. This normalizes the potential growth at all sites, so that site estimates are only different because of their available moisture reserves. Normalizing means that differences in yields due to the ambient heat available for growth at different locations do not appear in these estimates.

Baier and Robertson's (1966) soil moisture budget provides the required soil moisture term in the forage model which determines daily estimates of soil moisture reserves from daily weather data for a hypothetical water-holding capacity. The calculated daily moisture extraction throughout the season reflected a typical, perennial forage crop rooting pattern. The discussion of long-term drought expectations and the consequences of various definitions of drought are based on frequency distributions generated with these two computer models.

HISTORICAL WEATHER SIMULATIONS

A frequency distribution analysis was done for 30 years at 22 sites. Weather based simulations were made of soil moisture and relative forage growth on May 31 each year. For each site and soil type the 30 yearly estimates (for May 31) of both soil moisture and growth were sorted into ascending order to produce an accumulative frequency distribution. Each distribution gives a set of expected values and the probabilities of these values not being met or exceeded. In other words, these are probabilities of drought for a range of drought criteria. Normals (30-year averages) were also generated from these data for each site and soil type. Frequency distributions and normals were generated for both soil moisture and forage yields.

Distributions of forage growth and soil moisture representing dry, moderate, and wet sites are shown in Figures 1, 2, and 3. Each of these figures is the result of averaging distributions from the five most typical sites for each of the three dryness classes. The generalized 'dry' site is represented by Regina, Kindersley, and Saskatoon in Saskatchewan and by Vermilion and Medicine Hat in Alberta. The 'moderate' site includes Broadview, Estevan, Prince Albert, and North Battleford in Saskatchewan and Edmonton in Alberta. The 'wet' site includes Winnipeg, Brandon, and Portage la Prairie in Manitoba and Nipawin and Yorkton in Saskatchewan. Stations in Figures 1, 2, and 3 were grouped for this discussion so that changes from normally dry to normally wet locations could more easily be seen and

compared with the differences among soil types. (The terms dry, moderate, and wet are relative to the prairie region only and refer to the range of climates dealt with here.)

The range of soil types is based on four plant available water-holding capacities. These capacities are 100 mm, 150 mm, 200 mm, and 250 mm of water in the top 100 cm of soil. They approximately correspond to sand, loam, clay loam, and clay and are designated here as very light, light, medium, and heavy soils. Each soil type also has its own characteristic pattern of drying which is accounted for in the simulations. The soil moisture estimates correspond to those used in the mapping scheme described previously (Dyer *et al.* 1981).

INTERPRETATIONS OF PROBABILITY DISTRIBUTIONS

A graphical technique was developed to interpret the two types of distributions shown in Figures 1 to 3. These curves relate three variables – soil moisture reserves, forage yield expectations, and the probabilities of early estimates being less than or equal to each point on the curves. The shapes of the curves are controlled by two parameters – soil class and climate (site). Sub-figures 1a, 2a, and 3a indicate forage yield expectations and Sub-figures 1b, 2b, and 3b show soil moisture reserve expectations. The technique's principal assumption is that soil moisture and forage yield expectations are highly correlated. In the simulations the correlations are very high because the forage estimates are based only on soil moisture estimates. Since potential growth rates were normalized there are no differences in potential growth and the only differences are due to water shortage. Therefore, when a forage production level and a soil moisture level are expected with the same probability they will occur at the same time or during the same year.

By setting up frequency distribution graphs with a common probability axis, soil moisture reserves and forage yields can be equated on the basis of probability by vertical projections from the same point on the probability axis. Distributions for different soil types, of either soil moisture or forage yields, can also be equated on the basis of probability by using vertical projections. Equating on the basis of probability means that the selected levels of soil moisture or yield (intersection points with vertical projections) can be expected to occur at the same rate. Horizontal projections in Sub-figures 1a, 2a, and 3a provide intersection points which define equal forage yield expectations for the different soil types, based on water storage capacity. Vertical projections down from these intersection points define the probabilities of getting the chosen yield on the four different soil types.

In most applications threshold levels of soil moisture and yield will be defined in terms of percent of normal. The right-hand vertical axes of Figures 1 to 3 show percent of normal scales for different soil types. Making projections from the same value from all four right-hand scales allows the distributions from different soil classes to be equated on the basis of percent of normal.

The graphical procedure helps us answer several questions. If we assume a fixed value for one variable we can consider the consequences for the other two when they are equated on the basis of the one fixed variable. Each question requires a different starting point and sequence of projections in the set of graphs. There are three types of procedure.

First, when a fixed value of either soil moisture or yield is chosen for all four soil classes, horizontal projections are started from all four of the percent of normal scales. A vertical projection down from each appropriate intersection point on the curve defines a probability for each soil class. A different fixed value can be selected for each soil type.

The starting conditions of the second procedure are based on one benchmark soil class. A horizontal projection is made from only one of the percent of normal axes. Other values are chosen by equalizing one of the remaining variables. Equalizing involves shifting vertically to the other sub-figure, defining a percent normal for the benchmark soil and applying that percent of normal to the three remaining soil classes.

A third option is to start from a point on the probability axes. Either the same probability can be applied to all soil classes or probabilities for the three remaining soil classes can be derived after a probability has been chosen for a benchmark soil. In the second case the three derived probabilities would result from equalizing either soil moisture or yield thresholds.

The sequence of projections for the first type of procedure is illustrated in Figure 1. In this example a fixed level (65%) is chosen for percent of normal yield. Corresponding probabilities and soil moisture reserve thresholds are also defined for each soil type. The second procedure is illustrated in Figure 2. A fixed percent of normal soil moisture reserve (60%) is chosen for medium soil. The projections and intersection points illustrate the corresponding yields and probabilities on all soils and soil moisture on the other three soils.

RESULTS

Several trends are apparent in Figures 1 to 3. The below normal (left) sides of the dry distributions (Figure 1) are much flatter than those of the wet distributions (Figure 3), because of greater skewness in the dry distributions. This means that changes in probability for different soil types at equivalent levels of either soil moisture or yield

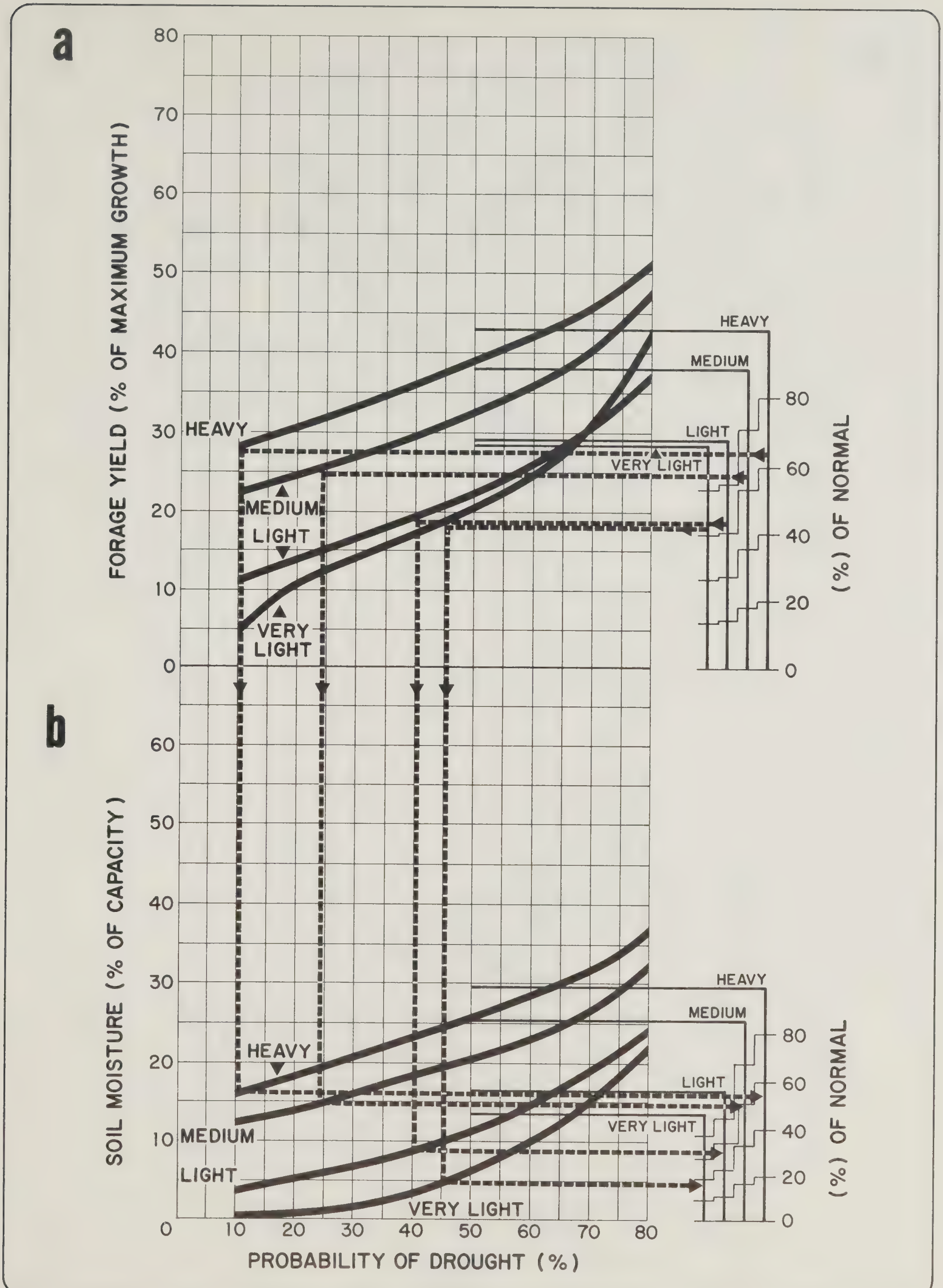

Figure 1. Dry site.

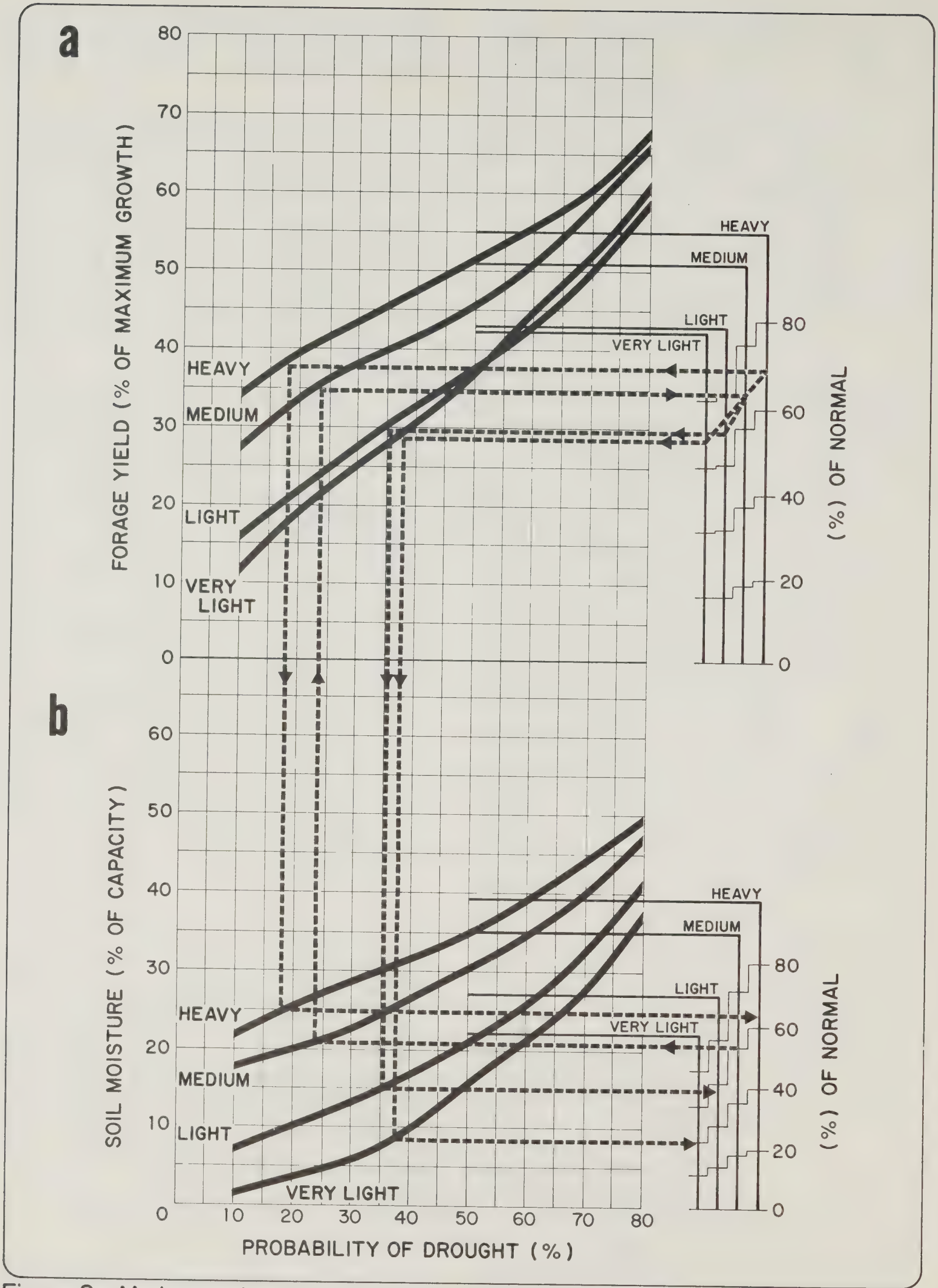

Figure 2. Moderate site.

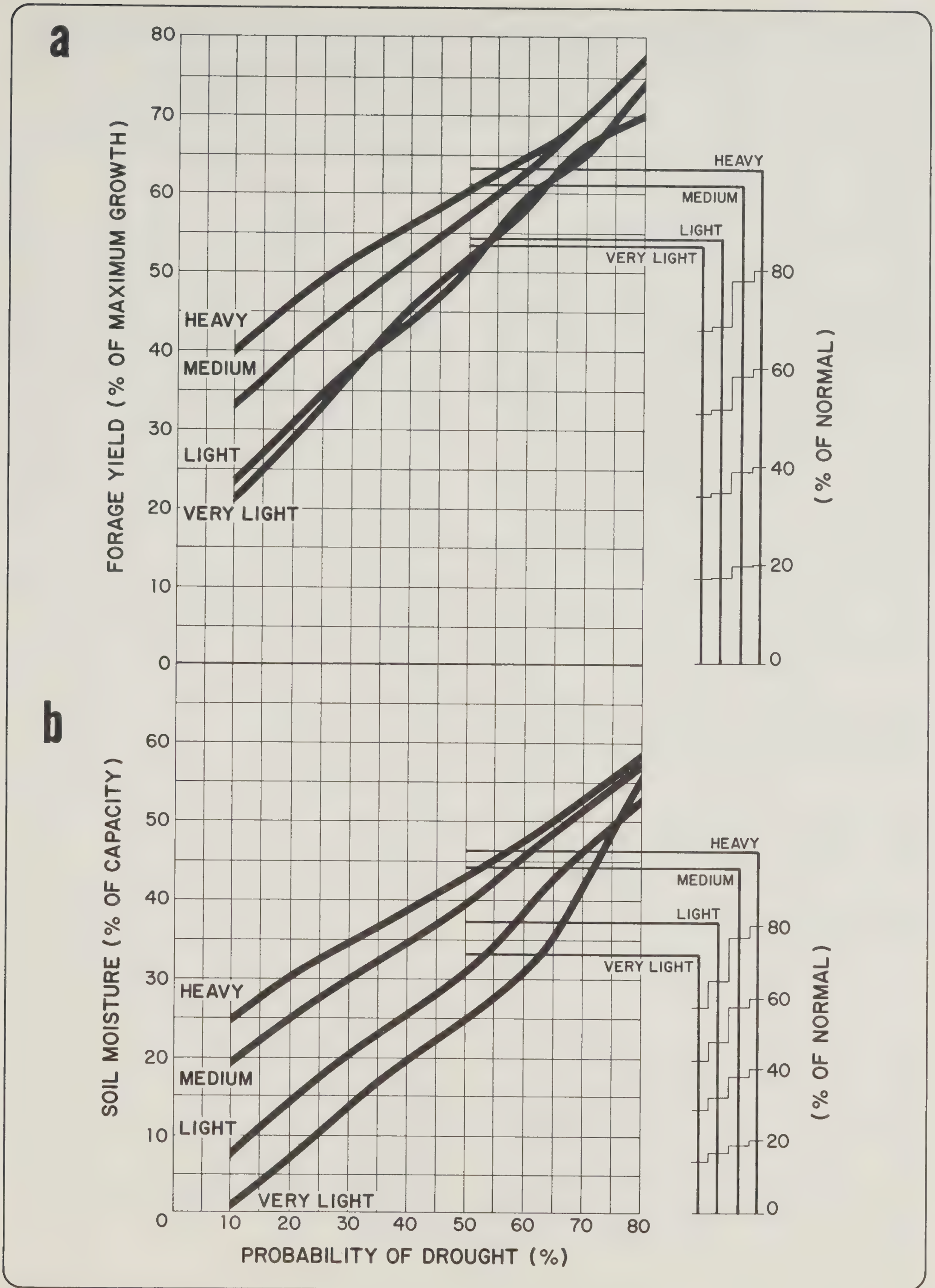

Figure 3. Wet site.

TABLE 1. THRESHOLD SOIL MOISTURE CRITERIA AND CORRESPONDING FORAGE YIELD EXPECTATIONS AND PROBABILITIES OF THESE CRITERIA NOT BEING EXCEEDED (DERIVED FROM FIGURES 1, 2, AND 3)

Soil moisture criteria (% of normal)		Yield (% of normal) Sites			Probability (%) Sites		
Soil type		Wet	Moderate	Dry	Wet	Moderate	Dry
Heavy	62	68	67	69	15	15	16
Medium	59	67	67	65	22	20	21
Light	55	69	67	66	30	33	40
Very light	35	67	67	64	29	35	43

will be much greater at the drier sites. Equating yields from different types of soil on the basis of percent of normal rather than percent of maximum growth (well watered) decreases these differences. There is also more skewness apparent in the soil moisture distributions (Sub-figures 1b, 2b, and 3b). The lighter textured soils also show more skewness at all sites.

There is a tendency for the upper right ends of the distributions to converge and intersect. However, these parts represent the wettest years which are not of major importance to this discussion. Generally, the forage model did not show as much difference between the light and very light soils as did the soil moisture model. Thus soil moisture values which give equitable yields are noticeably lower for the very light soils than for the other soil types.

The main question considered here is what can be expected when each of the three variables is held constant. These trends were determined on the basis of percent of normal expectations, using numbers extracted from Figures 1 to 3. At the same probability on all soils at all sites the general trend is for threshold values of both soil moisture and yields to increase from light to heavy soils. This trend was slightly more apparent for soil moisture reserves, particularly in the difference between very light and light soils. There is also a trend for both soil moisture and yield values to be lower at the dry sites and higher at the wet sites. This trend is more apparent on the very light and light soils and is more obvious for soil moisture.

When constant percent of normal thresholds for either soil moisture or yields are assumed on all soils and sites, probabilities of these thresholds not being exceeded are noticeably higher on the lighter soils. Also on the light and very light soils these probabilities increase at the drier sites. At constant soil moisture thresholds, corresponding yields are higher on the lighter textured soils. Constant yield thresholds, on the other hand, require soil moisture thresholds which are higher on the heavier soils. In either case the magnitude of changes between sites is small.

The implications of these trends affect the way that drought is defined. First, for drought to occur at probabilities which are similar on different textured soils, higher thresholds of either soil moisture or yields must be used on the heavier soils. Second, for the lighter textured, more drought prone soils, the site location has a considerable effect on the rate of occurrence or probability of drought, even though thresholds were selected on a relative, percent of normal basis. This is true whether soil moisture or yield is used to define drought threshold conditions.

In preparing a map of a drought area, soil moisture reserve estimates for four different soil classes were proposed as the mapping variable (Dyer *et al.* 1981). A uniform threshold level criteria for soil moisture must be applied to all sites. However, through the use of overlays, a composite drought map can be prepared for all classes of soil, so that separate criteria for each can be used. The graphs are used to select an illustrative set of soil moisture criteria for drought mapping. The two starting assumptions of the selection procedure are that (1) normalized yields should be equal and (2) that drought should occur 1 year out of 5 (20%) on medium soil in the moderate climate areas. In Figure 2 the percent of normal soil moisture on medium soil is 59% and the yield is 67% of normal at 20% probability. This yield level is used to select probabilities and soil moisture levels on the other three soils at the moderate site (Figure 2). The four soil moisture levels are then used in Figures 1 and 3 to select corresponding yields and probabilities at the other two sites. These selections are shown in Table 1.

As the derived soil moisture levels the corresponding yields are constant within 3% at all three sites and on all four soil classes. On heavy and medium soils the probabilities vary only slightly, but they change considerably among the three sites on the two lightest soils. Differences in probabilities between the soil types are also considerable.

These derived soil moisture thresholds trend to favor the lighter soils in that they allow drought to occur more often on lighter soil. Thus these soils are eligible for assistance more often. To reduce these differences, lower soil moisture thresholds could be used on light and very light soils. This would mean, however, that the threshold yields on the lightest soils would have to be lower as well.

DISCUSSION AND CONCLUSION

The climatic trends that affect this scheme are apparent in the degree of skewness in each set of distributions from the generalized sites (Figures 1 and 3). For instance, the relationship between the mean values (normals) and the mid-points of the distribution 50% probability is different for each group of sites. There are also significant changes in magnitude of normals with both soil type and climate. These two facts are basic in this analysis. Background climate therefore has a strong influence on the way that normals should be interpreted. The practice of normalizing yearly soil moisture estimates to long-term averages (or normals) without considering the corresponding probabilities, as was done here, can be misleading to long-term drought assistance planning.

The examples given demonstrate a strong interaction between the site location and soil texture. The risk of drought on low storage capacity soils (light and very light) rises sharply from that for the heavier soils when these soils are located in normally dry regions despite having defined drought on a normalized basis.

To delineate drought areas, maps can be prepared for long-term expectations. Frequency distributions of soil moisture generated for all sites would have to be used to derive the value at each site. In an actual drought year situation the soil moisture model used here would be applied to weather records from the current year at each site. To define the drought area, criteria for drought chosen by the method described here would be applied to estimates from each site. These current year estimates must be made with the same model that was used to generate the criteria. Details of a drought area mapping procedure based on soil moisture are in Dyer *et al.* 1981.

The essence of the method presented here is that it allows for several interpretations. This flexibility allows users to set the priorities in their concerns for drought and evaluate the possible consequences. Questions to be faced in defining drought are how often should special measures be required to offset drought losses, how much area should be included in the defined drought area, and how much disparity should there be in defining drought for drought-prone regions compared with non-drought-prone regions.

The results presented in this paper are crude, preliminary estimates based on summaries for a limited number of stations. However, the general trends from stations which are normally wet compared with those which are normally dry are shown by the grouping of stations to produce the generalized sites shown in Figures 1, 2, and 3. The method is still site specific, so the results must be interpreted to define broad areas.

The use of probabilities to select drought criteria should help us to better understand the impact of drought on beef producers. It still remains to choose the correct levels of probabilities on which drought assistance should be based. In this analysis these probabilities were selected intuitively. If the probability levels used in this procedure could be related to economic factors governing beef production, then the economics of drought could be assessed more explicitly. Studying this last aspect would bring together the economic and the environmental resource points of view of drought.

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Agricultural trade - 1980

Increased volume of agricultural trade from the United States, Canada, Australia, and Argentina during the 1970s minimized the effects of slow growth of supply and increased world demand. Canada's agricultural exports in 1980 reached $7.8 billion and imports advanced to $5.1 billion. Agricultural forecasters predict that the 1980s will see continued slow growth of supply, increased world demand, and a high degree of future market instability.

G. Labrosse and E. McSorley

REVIEWING THE AGRICULTURAL SCENE

Agricultural surpluses dominated the world agricultural scene during the 1950s and 1960s. The production capabilities of food exporting countries grew faster than world demand; hence real prices on the world market for agricultural products declined and consumers enjoyed relatively low food prices. World agriculture was in disequilibrium.

In the 1970s this problem moved to the opposite extreme. Policy changes, rapid population growth (partly the result of improved health care around the world), and the almost universal preference of most people to consume more meat, poultry, and dairy products as their income rose, caused unprecedented growth in import demand for food. There was a noticeable increase in demand for grains and oilseeds which are used heavily in meat, poultry, and dairy product production.

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By the mid-1970s the growth in agricultural production seen in the 1950s and 1960s had begun to slow down. Higher energy and fertilizer prices as well as the uncertainty created by inflation and faltering economic growth caused difficulties for many agricultural producers.

The mid- and late 1970s were characterized by slow growth in agricultural production (especially in newly developed regions which required larger amounts of high energy inputs), increased variability in year to year production and consumption, and a marked increase in world trade. The Soviet policy of importing large quantities of grains, when Soviet crops could not meet their needs, was becoming entrenched. All these developments significantly increased the world's dependence on a few exporters, created considerable uncertainty, and increased market instability.

As the gap between food supply and demand narrowed, other economic developments had a strong impact on agricultural trade. The sharp rise in the inflation rate was among the most important. This was a worldwide problem, the result of complex interactions between both supply and demand. The increase in petroleum prices in 1973-74 and again in 1979 caused reduced demand for many agricultural products which added to the inherent instability of world agricultural markets. There were exceptions, however, as increasing oil revenues in oil-exporting countries strengthened their demand for food. Further uncertainty caused by fluctuating exchange rates persuaded governments to institute policies which would insulate their producers from the damaging effects of worldwide fluctuations.

The expansion of international trading blocs, such as the European Economic Community, meant that agricultural exporting countries like Canada had to make continuing significant adjustments in their exports. However, this tendency had been in existence for decades. It is not only a phenomenon of the 1970s.

The increased volume of agricultural trade, particularly towards the latter part of the decade, played a major role in minimizing the global food problem. To a increasing extent a few exporters supplied this trade.[1]

As we enter the 1980s considerable uncertainty remains. Growth in world population and effective demand is expected to put continuing pressures on world food supplies. While it is uncertain to what extent this pressure will lead to higher, real agricultural prices, we

[1] Four countries – the United States, Canada, Australia, and Argentina – now supply about 85% of the grain traded on the world market.

are more certain that wide fluctuations in world market conditions will continue. This instability will mean that accelerated efforts will be required to expand trade opportunities.

CANADA'S AGRICULTURAL TRADE

Canada is one of the world's four major grain exporting countries and trade in agricultural products has always been important to the Canadian agriculture sector. Agricultural exports were about 40% of total farm cash receipts in 1980.[2] Because of the world's growing dependence on farm exports from North America, the importance of agricultural trade to the Canadian economy as a whole may increase in the future. In 1980, agricultural trade contributed a surplus of $2.7 billion to Canada's total merchandise trade surplus of $5.1 billion.

CANADA'S AGRICULTURAL EXPORT TRADE

The value of Canadian agricultural exports increased dramatically during the past 10 years. Figure 1 shows the value of exports and imports of agricultural products from 1965 through 1980. The value of agricultural exports between 1979 and 1980 increased 28%, reaching $7.8 billion. Canada's principal exports of agricultural commodities included wheat, rapeseed, cattle, pork, horticultural products, and dairy products.

From Table 1 we see that in 1980 Canada was a net exporter of grains, grain products, animal feed, oilseeds, live animals, meats, dairy products, and other animal products. (Canada became a net exporter of meat in 1979, when fresh and frozen beef exports increased sharply.)

The value of Canadian grain exports increased about 60% in 1980, to a value of $4.4 billion. Wheat is our largest export commodity, with a value of $3.8 billion in 1980, 48% of the total value of agricultural exports. This was a considerable increase from the unusually low share of 36% recorded in 1979 when the export volume of wheat was relatively low. Figure 2 shows the export value of major agricultural commodity groups in relation to total agricultural exports.

Rapeseed is Canada's major oilseed export. The export value of all oilseeds declined to $646 million in 1980, down 25% from the previous year's level. This reflects the reduction in seeded area due to high stock levels during the previous crop year and prairie drought conditions in the spring. The oilseed share of the total value of agricultural exports declined from 14% in 1979 to 8% in 1980.

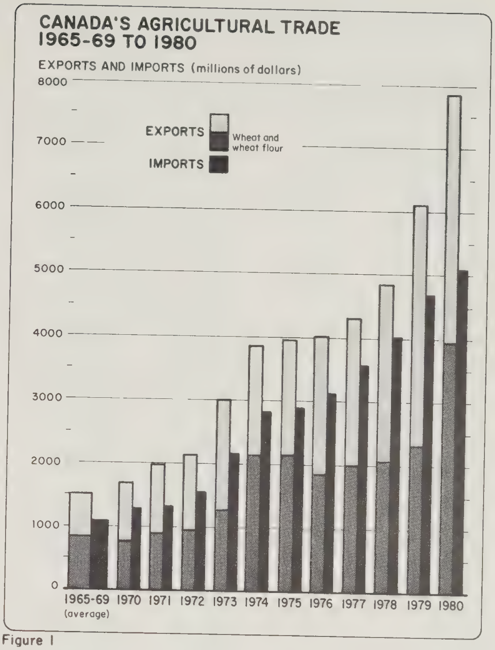


Figure 1

Table 2 gives details of Canada's agricultural export commodity groups and the major commodities within each group for the past 3 years. Both value and volume are shown because changes to total traded value mean little, without knowledge of whether these changes were the result of a price or volume change or both.

CANADIAN AGRICULTURAL IMPORTS

The value of agricultural imports has increased substantially since 1970, although not to the same extent as the value of exports (Figure 1). Canadian agricultural imports were valued at $5.1 billion in 1980, up 9% from the 1979 import value. Major agricultural import commodities are citrus fruits, grapes, bananas, fresh vegetables, raw sugar, coffee, and spices.

In 1980, Canada was a net importer of fruits, nuts, vegetables, oilseed products, seeds for sowing, sugar, vegetable fibers, and plantation crops. Although we export some commodities from each of these groups, our imports greatly exceed our exports (Table 2).

About 60% of Canada's agricultural imports can be classified under 4 main commodity groups. These are fruits and vegetables, livestock and livestock products, plantation crops, and oilseeds and products (Figure 3). There were small changes (1 to 2%) in the import commodity shares for most import commodity groups

[2] This statement must be interpreted with caution because products are being valued at different phases of the food chain. In particular, the statement does not mean that 40% of gross farm income is derived from exports.

TABLE 1. TRADE BALANCES BY MAJOR AGRICULTURAL COMMODITY GROUP, 1980

Commodity Group	Exports	Imports	Trade Balance
		$'000	
All commodities	74 228 694	68 979 363	5 249 330
Agricultural products	7 844 615	5 107 164	2 737 451
Grains	4 447 175	219 831	4 227 344
Grain products	336 904	108 334	228 570
Animal feeds	184 867	58 264	126 603
Oilseeds	645 500	200 046	445 454
Oilseed products	202 875	267 596	−64 721
Live animals	228 848	87 871	140 977
Meats	514 173	286 888	227 285
Other animal products	420 684	319 558	101 126
Dairy products	159 538	87 779	71 759
Poultry and eggs	44 906	56 369	−11 463
Fruits and nuts	80 208	1 008 292	−928 084
Vegetables	160 366	469 273	−308 907
Potatoes	56 175	29 531	26 644
Seeds for sowing	36 308	54 900	−18 592
Maple products	15 398	—	15 398
Sugar	11 456	527 358	−515 902
Tobacco	74 299	35 440	38 859
Vegetable fibers	8 416	132 519	−124 103
Plantation crops	5 427	785 204	−779 777
Other agricultural products	211 092	372 111	−161 019

Source: Agriculture Canada, "Canada's Trade in Agricultural Products," annual.

in 1980. But the fundamental structure of Canada's agricultural imports has not changed significantly during the past decade. The structure of Canada's agricultural export trade has also remained stable.

In 1980 there was a sharp rise in the value of imported sugar. It increased from 5% of the total value of agricultural imports in 1979 to 10% in 1980. This was due to a large increase in the world price of sugar during the year, the result of dwindling sugar stocks in response to lower production levels in the major sugar producing countries. The quantity of sugar imports fell about 10% during 1980 in response to price increases and partly increased domestic production of high fructose corn sweetener.

Canada imports large quantities of fresh fruits and vegetables, especially during the winter when the Canadian climate does not permit fruit and vegetable production (except in greenhouses). In 1980 we imported $540 million worth of fresh fruit and $324 million worth of fresh vegetables (Table 3). Citrus fruits in various forms (i.e., fresh, juice, frozen, or concentrated) are the major fruit import. The value of citrus fruit and juice imports in 1980 was $290 million, about the same as in 1979. Bananas and grapes are also important fruit imports with values of $98 million and $108 million in 1980. Coffee products are another important Canadian import commodity. The value of coffee imports reached nearly $500 million in 1980.

TRADE OUTLOOK FOR THE 1980s

Many agricultural forecasters predict that the agri-food sector of the 1980s will experience slow growth of supply (or at least insufficient to keep up with growing demand), greater world demand, increased fluctuation in year to year demand and supply, and a rising trend in real prices with considerable year to year variation. If so, the agricultural sector will be required to make significant adjustments to face these new conditions which are the opposite to those of the 1950s and 1960s when there was ample supply and relative stability. For Canada's farm sector, the sharp increase in the export price of Canadian wheat during the past few years and the large 43% increase in the volume of Canadian wheat exports in 1980 may be a glimpse of the variation that can be expected throughout the 1980s.

TABLE 2. CANADIAN AGRICULTURAL EXPORTS BY MAIN COMMODITY, 1978, 1979, and 1980

Commodity	Unit	1978 Volume	1978 Value	1979 Volume	1979 Value	1980 Volume	1980 Value
		'000	$'000	'000	$'000	'000	$'000
Total ag. exports		–	4 852 475	–	6 107 974	–	7 844 615
Grains	(t)	18 688	2 385 679	16 140	2 773 606	20 885	4 447 175
Wheat	(t)	14 426	1 911 825	11 692	2 179 318	16 757	3 795 029
Barley	(t)	3 600	384 244	3 933	509 040	2 732	404 183
Grain products	(t)	941	263 093	881	279 584	842	336 904
Hard spring wheat flour	(t)	553	128 436	478	119 783	336	110 168
Animal feeds	(t)	1 280	123 577	1 396	168 329	1 344	184 867
Oilseeds	(t)	1 853	543 672	2 727	862 759	2 018	645 500
Flaxseed	(t)	410	102 535	535	168 787	402	137 265
Rapeseed	(t)	1 208	369 550	1 988	631 445	1 358	421 902
Oilseed products	(t)	346	115 034	338	140 673	490	202 875
Oil cake and meal	(t)	225	38 649	193	36 290	294	65 245
Rapeseed oil	(t)	103	66 676	119	85 074	173	118 785
Live animals		–	195 597	–	223,641	–	228 848
Cattle	(no.)	469	165 205	369	196 298	358	188 473
Meats	(t)	149	309 160	185	427 665	245	514 173
Beef and veal[a]	(t)	31	64 601	38	106 615	46	123 240
Pork[a]	(t)	52	171 772	76	222 708	114	276 403
Other animal products	(t)	–	301 895	–	438 775	–	420 684
Furs, hides and skins	(t)	–	191 511	–	294 857	–	273 234
Cattle hides, raw	(no.)	3 237	95 152	2 650	136 706	2 898	104 325
Dairy products	(t)	184	92 806	188	121 795	188	159 538
Skim milk powder	(t)	124	56 516	93	47 443	60	46 135
Evaporated milk	(t)	35	18 903	74	55 022	102	87 138
Poultry and eggs		–	27 141	–	25 348	–	44 906
Fruits and nuts	(t)	95	66 798	90	71 977	99	80 208
Apples	(t)	56	25 803	55	29 539	60	33 252
Vegetables	(t)	197	76 556	277	113 034	340	160 366
Dried vegetables[b]	(t)	68	27 052	117	45 602	178	75 669
Potatoes	(t)	152	25 513	188	36 487	276	56 175
Seeds for sowing	(t)	35	31 775	37	36 845	33	36 308
Maple products	(t)	5	11 116	8	15 004	6	15 398
Sugar	(t)	123	46 336	110	50 582	13	11 456
Tobacco	(t)	33	99 679	39	137 527	19	74 299
Vegetable fibers	(t)	36	7 132	29	7 915	40	8 416
Plantation crops	(t)	2	9 398	2	9 033	1	5 427
Other ag. products		–	120 518	–	167 395	–	211 092
Peat and other mosses	(t)	317	43 069	368	59 895	395	69 298

Source: Statistics Canada.
[a]Fresh or frozen (excluding edible offals).
[b]Mostly peas and beans.

It is by no means certain that this scenario will come to pass. During the 1970s, real agricultural prices appear to have resumed the long-term decline experienced during most of this century. Indeed it may turn out that the 1973-75 period of high prices is another of those aberrations that the world experiences every decade or so (such as at the end of World War I and during the late 1940s and early 1950s). Nevertheless, forecasters are more confident of the high degree of future market instability.

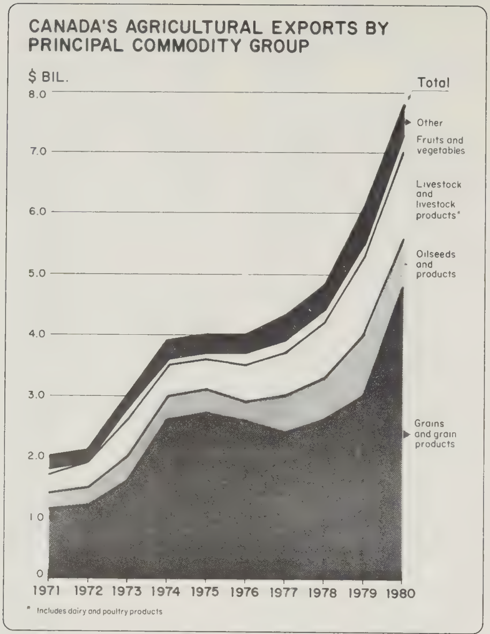


Figure 2

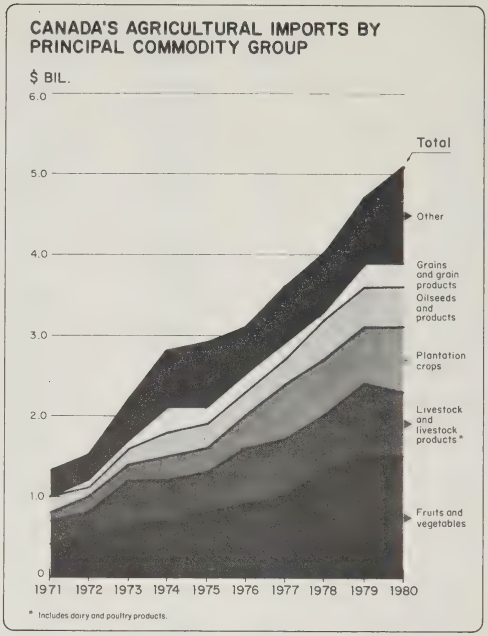


Figure 3

Supply growth for the next 10 years is expected to be slow because the possibilities for resource expansion are limited. Throughout the world most of the relatively fertile cropland is already in use. This means that productivity gains in the 1980s will have to be the result of improved farm practices rather than resource expansion. Productivity growth will depend on increased usage of available technology, expansion of the supply of low priced inputs, improved production techniques, and improved management systems (especially in the less developed countries where the marginal increase in productivity will be the greatest). To increase agricultural productivity, we must deal with problems of rising costs of energy related imports, increasing scarcity of land and water, and numerous environmental concerns.

A large part of the rising demand for food in the 1980s is expected to come from the less developed countries. Even though demographers predict lower population growth rates for these countries between 1980 and 1985, the changing per capita caloric food requirements associated with the advancing age of their populations will keep demand for food growing at record rates.

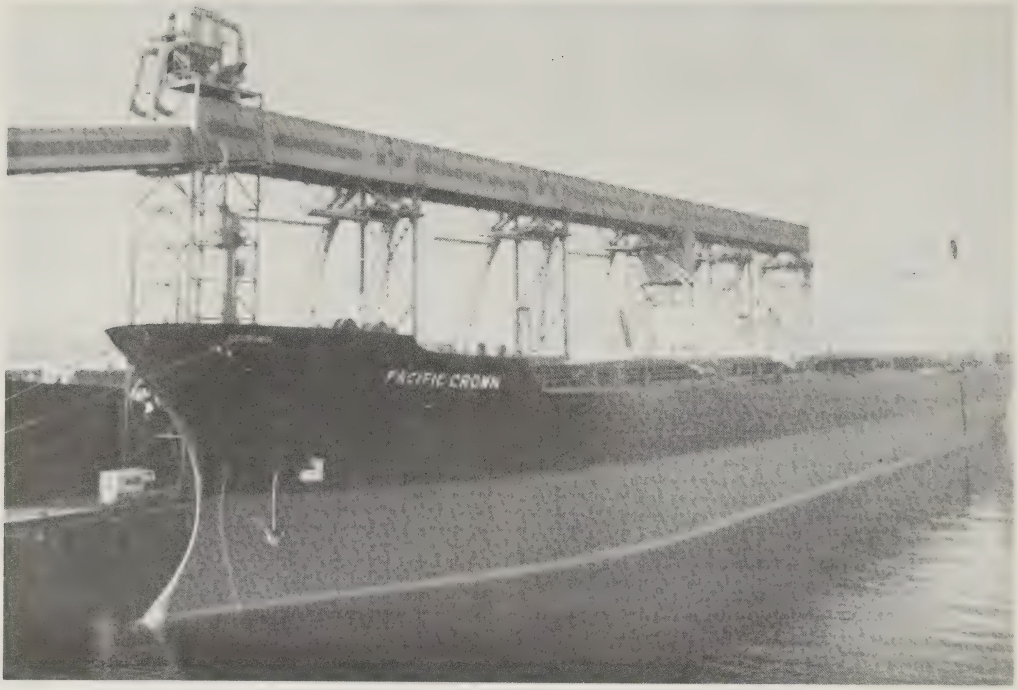
The trend toward increased cultivation of marginal land, especially outside North America, will complicate the increasingly tight balance between supply and demand. Marginal land is far more subject to crop failures, and as the dependence on marginal cropland increases so will fluctuations in yield. In turn, both foreign supply and demand will tend to vary widely from year to year, increasing instability in international markets. It is expected that dependence on North American grain and oilseed exports will continue. The outcome of all these factors – slow growth in supply, rising demand, and increasing market instability – will likely be higher prices on the world's international agricultural markets.

Canada's five major export markets (in descending order of importance) are the European Economic Community, the United States, Japan, the U.S.S.R., and the People's Republic of China. Except for the United States and Japan, which compete with each other for second place, the order remained unchanged for many years, until in 1980 the U.S.S.R., for the first time, became Canada's leading agricultural export market based on value of exports. This was due to significant increases in grain exports. In May, 1981 Canada signed a long-term agreement with the U.S.S.R. for the sale of a minimum of 25 million tonnes of Canadian wheat and feed grain during the next 5 years. This new agreement is in effect from August 1, 1981 to July 31, 1986. Thus the U.S.S.R. should continue to be an important market for Canadian grain.

TABLE 3. CANADIAN AGRICULTURAL IMPORTS BY MAIN COMMODITY, 1978, 1979, AND 1980

Commodity	Unit	1978		1979		1980	
		Volume	Value	Volume	Value	Volume	Value
		'000	$'000	'000	$'000	'000	$'000
Total ag. imports		–	4 016 363	–	4 681 523	–	5 107 164
Grains	(t)	502	84 552	893	143 648	1 289	219 831
Corn	(t)	420	47 350	803	101 122	1 197	169 420
Grain products	(t)	149	79 282	159	91 316	211	108 334
Bakery products	(t)	25	37 956	25	40 857	25	43 859
Animal feeds	(t)	211	42 974	239	53 994	265	58 264
Oilseeds	(t)	406	154 035	442	176 321	545	200 046
Soya beans	(t)	324	91 245	351	107 806	477	141 901
Oilseed products		–	264 164	–	299 538	–	267 596
Oil	(t)	142	148 127	130	162 310	116	148 018
Oilcake and meal	(t)	414	103 281	466	131 580	404	113 152
Live animals	(t)	–	56 571	–	47 547	–	87 871
Cattle	(t)	26	36 833	11	21 410	32	60 549
Meats	(t)	151	331 248	124	332 374	94	286 888
Beef and veal[a]	(t)	66	147 545	56	182 354	53	177 297
Pork[a]	(t)	48	110 805	28	62 808	13	30 645
Mutton and lamb[a]	(t)	15	25 944	18	41 074	13	37 861
Other animal products		–	231 367	–	362 751	–	319 558
Hides, skins and furs	(t)	–	131 952	–	244 155	–	196 226
Wool, raw	kg	8 856	38 847	10 002	51 374	7 921	46 026
Dairy products	(t)	33	78 446	32	80 937	28	87 779
Cheese	(t)	21	66 024	21	70 867	20	74 591
Poultry and eggs		–	59 111	–	72 907	–	56 369
Shell eggs[b]	doz	14 584	19 553	21 056	26 992	11 720	17 506
Fruits and nuts	(t)	1 437	818 277	1 482	968 584	1 493	1 008 292
Citrus, fresh and processed	(t)	498	243 581	476	279 039	528	279 370
Bananas	(t)	236	74 688	249	90 575	246	98 458
Grapes	(t)	116	80 242	145	102 567	136	108 195
Vegetables	(t)	902	413 245	933	476 671	936	469 273
Fresh vegetables	(t)	745	278 676	766	316 990	791	324 158
Potatoes	(t)	177	32 653	177	26 257	121	29 531
Seeds for sowing	(t)	24	40 609	33	57 241	31	54 900
Sugar	(t)	1 057	211 277	1 043	251 271	941	527 358
Tobacco, raw	(t)	6	10 661	3	8 949	8	35 440
Vegetable fibers	(t)	85	94 134	87	115 949	85	132 519
Cotton, raw	(t)	58	85 100	59	105 429	62	122 704
Plantation crops	(t)	229	717 389	240	777 762	224	785 204
Coffee and products	(t)	89	438 947	94	464 670	91	485 225
Tea and products	(t)	23	58 464	22	58 207	24	64 846
Other ag. products		–	296 368	–	337 506	–	372 111
Spices, flavorings and confectionery		–	110 457	–	119 758	–	130 458

[a]Fresh or frozen.
[b]Includes hatching eggs.



Canadian grain leaves Vancouver for the U.S.S.R.

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Economic Indicators

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE

Item	Units or Base	1979 III	1979 IV	1979 Annual	1980 I	1980 II	1980 III	1980 IV	1980 Annual	1981 I	1981 II
Production and income											
1. GNP at market prices[a]	$ mil.	266 624[b]	275 260[b]	261 224[b]	280 368[b]	284 368[b]	291 052[b]	303 792[b]	289 859[b]	315 100[b]	325 604[b]
2. Farm cash receipts, total[d]	$ mil.	3 460.3	4 096.7	14 258.4	3 796.8[b]	3 460.1[b]	3 931.6[b]	4 450.5[b]	15 639.0[b]	5 503.9[b]	4 027.8
3. — total crops[d]	$ mil.	1 480.9[b]	1 975.6[b]	6 128.7[b]	1 331.9[b]	1 360.7[b]	1 721.7	1 967.8[b]	6 882.1[b]	3 279.3[b]	1 600.9
4. — total livestock[d]	$ mil.	1 886.3[b]	2 031.8[b]	7 733.3[b]	1 900.7	1 974.6	2 118.1	2 324.3	8 317.7	2 120.6[b]	2 268.2
5. Net income rec'd by farm operators[a]	$ mil.	2 868.0[b]	3 936.0[b]	3 690.0[b]	3 184.0[b]	2 788.0[b]	3 436.0[b]	3 263.0[b]	3 263.0[b]	5 048.0[b]	4 728.0
Trade											
6. Agricultural exports	$ mil.	1 663.9	1 884.8	6 107.8	1 501.5	2 008.2	2 003.5	2 331.4	7 844.6	1 906.6	4 280.3
7. Agricultural imports	$ mil.	1 129.4	1 240.4	4 680.6	1 158.9	1 256.9	1 173.6	1 517.8	5 107.2	1 406.5	2 804.2
8. Real domestic product, Ag[a]	1971 = 100	98.0[b]	102.2[b]	103.7[b]	105.8[b]	108.1[b]	105.3[b]	103.7[b]	105.7[b]	112.9[b]	111.8
9. Real dom. prod., less Ag[a]	1971 = 100	141.9[b]	141.6[b]	151.4[b]	141.0[b]	140.1[b]	140.4[b]	142.6[b]	141.0[b]	144.6[b]	146.4
Price indexes											
10. Farm input price index	1971 = 100	236.1	239.6	234.9	253.2	250.3	258.6	267.5	257.4	281.2[b]	290.6
11. — buildings and fencing	1971 = 100	229.5	235.3	226.0	235.5	236.4	242.2	242.7	239.2	247.3	260.6
12. — machinery & motor veh.	1971 = 100	196.2	205.3	193.3	214.2	221.7	227.0	237.4	225.1	248.0	260.7
13. — crop production	1971 = 100	258.5	266.5	254.0	296.9	309.1	304.9	310.7	305.4	334.2[b]	343.8
14. — animal production	1971 = 100	249.2	247.8	249.0	252.7	232.8	256.2	266.8	252.1	269.9	267.4
15. — hired farm labor	1971 = 100	235.7	237.8	233.6	242.1	245.1	249.2	253.1	247.4	257.7	264.4
16. — interest	1971 = 100	395.3	395.3	395.3	466.7	460.9	448.7	473.1	462.4	553.7	610.4
17. Farm prices of Ag. prod.[d]	1971 = 100	258.3[fb]	251.9[fb]	255.7[fb]	262.8[fb]	257.1[fb]	277.5[fb]	291.2[fb]	272.2[fb]	287.9[fb]	292.0
Input and credit											
18. Farm impl. & equip. sales[e]	$ mil.	N.A.	N.A.	1 701.0	N.A.	N.A.	N.A.	N.A.	1 745.0	N.A.	N.A.
19. Employment in agriculture[a]	'000	475.7	481.0	483.8	490.0	478.0	466.0	478.0	478.0	477.0	478.0
20. Av. farm labor rates	$/h	4.01	4.08	3.98	4.15	4.22	4.24	4.31	4.23	4.37	4.44
21. Av. hourly earnings-manuf.	$/h	7.50	7.68	7.44	7.89	8.04	8.28	8.53	8.19	8.78	9.07
22. F.C.C. — gross loan disburs.	$ mil.	192.4	145.2	547.7	98.5	189.6	139.3	95.8	427.4	74.0	171.5
23. CPI — all items	1971 = 100	193.1	197.6	191.2	202.0	207.6	213.5	219.5	210.6	226.6	233.7
24. — food at home	1971 = 100	241.6	243.8	238.0	250.3	258.2	270.3	279.4	264.5	288.5	294.8
25. — food away from home	1971 = 100	227.3	232.4	223.4	237.1	240.7	246.6	251.8	244.1	257.3	264.5
26. Industry selling price index — food & beverage	1971 = 100	233.3	237.5	231.7	244.2	247.9	260.5[b]	273.8[b]	256.6[b]	275.5	277.4

continued

MARKETING AND ECONOMICS BRANCH
QUARTERLY ECONOMIC INDICATORS FOR AGRICULTURE (Concluded)

Item	Units or Base	1979			1980					1981	
		III	IV	Annual	I	II	III	IV	Annual	I	II
Other indicators											
27. Unemployment rate	%	7.1	7.3	7.5	7.5	7.7	7.5	7.4	7.5	7.3	7.1
28. Exchange rate	$ U.S.	1.17	1.19	1.17	1.16	1.17	1.16	1.18	1.17	1.19	1.20
29. Chartered banks' rate on prime business loans	%	12.67[b]	14.96[b]	12.91[b]	15.25[b]	14.58[b]	12.29[b]	14.92[b]	14.26[b]	18.08	19.25
30. Quarterly pop. est.	mil.	23.70	23.76[b]	23.67	23.83[b]	23.89[b]	23.96[b]	24.03[b]	23.94[b]	24.09	24.15

[a]Seasonally adjusted at annual rates.
[b]Revised.
[c]Preliminary.
[d]Excludes Newfoundland.
[e]Excluding repair parts.
[f]Based on current initial prices for wheat, oats, and barley in Alberta, Saskatchewan, and Manitoba.

Sources: All items are from the *Canadian Statistical Review,* Statistics Canada, Catalogue No. 11-003; Agriculture Canada, ***Marketing & Economics Branch;*** Statistics Canada, Catalogue No. 71-001 and Catalogue No. 21-002; the Farm Credit Corporation; or the *Bank of Canada Review.*

Notes

A VECTOR TECHNIQUE FOR DETERMINING FREQUENCY DISTRIBUTIONS OF CLIMATIC VARIABLES

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INTRODUCTION

Risk analysis plays an important role in helping us to understand the impact of climate on agricultural planning. In many cases farmers can alleviate crop production problems arising from poor weather by using certain practices which usually require additional cost in equipment and labor. An example is irrigation during drought. To justify the cost of these measures, the economic losses caused by unfavorable weather must be weighed against the chances of such periods occurring.

Frequency distributions of critical weather conditions are essential tools in fulfilling this role. This note describes a simple numerical technique for producing frequency distributions from climatic records that can be presented as histograms.

An approach commonly used in generating frequency distributions is to sort randomly occurring events into groups according to their relative sizes. One example is the way in which engineers classify high intensity storms and peak runoff rates to quantify risk of flood damage (Schwap *et al.* 1966). The largest storm occurring in 50 years of records would be assumed to have an average return period of 50 years and be labeled a 50-year storm. The largest storm occurring in 25 years would be labeled a 25-year storm and so on, with less intense storms having shorter return periods.

When the total number of events is reasonably small but there is a wide range in possible outcomes for each event, then the simplest method of sorting is by making comparisons of pairs of items in the sequence. To put the largest first and smallest last, the first event is compared to all others in the sequence and any event exceeding it is inserted ahead of it so that the largest event occupies position one. This is repeated with the second position and the remaining events. Similarly, for the third, fourth, and nth positions, the procedure continues until the smallest event is left in the last position. This approach has been used to analyze events that occur once a year, such as the last expected frost date each spring or the number of frost-free days each summer (Edey *et al.* 1968). There are variations on this technique which can reduce the computations required under certain conditions (Wirth 1976). This approach is generally inefficient for large data sets, however, because repeated scanning of the sequence is needed. It is particularly inefficient when the sorted array is used to produce a histogram, since subsets of sorted items within the array are grouped into class intervals. This means discarding part of the information gained from the repeated scanning.

PROCEDURE

When the number of events is large and the possible outcome of each event is limited to a small set of whole numbers, sorting can be done more efficiently by the method described here. A one-dimensional array (vector) of length m is chosen, where m is the number of possible outcomes of each event (Y). The sequence of events is scanned only once and each event of magnitude j (where j = 1 to m) is stored as one count in the jth position of the vector. Thus each vector subscript defines a frequency class interval. Counts (X) of events which fall into each class (j) are made as follows:

$$X_j = X_j + 1 \qquad \text{if } Y_i = j$$

where i = 1 to n and n is the total number of events in the sequence.

The number of counts for threshold values can be determined by making the procedure accumulative. For example, the number of events less than or equal to 4 includes the sum of events equal to 0, 1, 2, 3, and 4. This means that $Y_i = j$ would be replaced by $Y_i \leq j$ in the counting procedure.

By expressing each count as a percent of the total number of events in the sequence (n), the frequency of occurrence (F) for each possible outcome can be calculated. Note that F is only an estimate of probability. For example, F_j calculated for a given 10 years will not necessarily be the same in the next 10 years, but does represent the most likely expectation.

APPLICATION

This numerical procedure has been applied to several derived climatic variables used in planning farm field operations. These variables include singularly occurring or non-sequential events, for which the chances for the number of these events occurring in a given period are required. Examples are spring and fall field workdays (Dyer *et al.* 1978 and Dyer 1980a) and potential harvesting hours for small grain cereals in the Maritime Provinces (Dyer and Bootsma 1979). Sequential events for which the chances for different lengths of sequences are being estimated have also been studied with this procedure. Examples are the required drying periods for field cured hay (Dyer and Brown 1977 and Dyer 1980b) and sequences of rain-free days (Dyer 1980b).

Using the example of workdays, j is each possible number of workdays which can occur in a period m-1 days long. Thus j = 1 to m represents 0 to m-1 workdays in each period. The number of events to be scanned (n) is the number of years analyzed. Where j is a sequence rather than a number of individual events, the total number of events to be scanned (n) is the product of the number of years and the number of possible starting dates for sequences in the calendar period being considered. Using the example of hay drying, n is the total possible number of cutting days in all years and j is each maximum possible number of days required to dry hay, considering every day in the period as a possible cutting day. The procedure was used in an analysis of the chances of field-drying hay in 4 days or less and the number of cutting days per week which result in 4-day-or-less field-drying periods (Dyer and Selirio 1977).

By using a two-dimensional array the season can be divided into periods (e.g., weeks) in which the columns store the counts of different possible outcomes and each row represents a repeat of the procedure for each weekly period. The season was split into periods in all the sample studies cited here.

DISCUSSION

The key to the technique is that a vector array stores counts of weather related events whose outcomes can be classified into discrete categories. The subscripts of the array index the different possible outcomes. The method represents a simple alternative to fitting probability models to an observed distribution in order to do a risk analysis. It also provides a comparison for probability estimates that are based on assumed or fitted probability models. Similarly, using it to present frequency distributions graphically can aid in the fitting of smoothing functions to frequency distributions. Hay drying periods (Dyer and Selirio 1977) are an example of an application for which a mathematical model was not available to describe their probability distributions.

This method is ideally suited to binary variables that represent 'go or no-go' situations, such as field workdays. The method can be applied to any weather based variable which does not need to be continuous. This may require transformation of the data so that each frequency class that includes a range of outcomes can be represented by an integer (j). It can be applied to data sets whose probability distributions are not known or which are too small to fit a probability model reliably. It is computationally simple since the sequence is only scanned once. It requires only a limited amount of information to be stored during computation, so it could be applied to large data sets and adapted to the computer as a general method for generating histograms. Although the only applications discussed here were to climatic variables, the procedure could be used with other types of randomly occurring variables that may be a source of risk in agricultural planning.

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Schwap, G.O.; Frevert, R.K.; Edminster T.W.; and Barnes, K.K. *Soil and Water Conservation Engineering,* 2nd ed. New York: John Wiley and Sons, Inc., 1966.

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PROPOSED AMENDMENTS TO THE FARM CREDIT ACT

Legislation was recently tabled in Parliament which will allow Farm Credit Corporation Canada (FCC) to obtain additional funds from sources other than the Government of Canada. This legislation is intended to ensure that Canadian agriculture has a constant and sufficient supply of lont-term credit to meet the goals set for it in the government's agri-food strategy.

The type of assistance available through FCC is essential for young and beginning farmers as well as others who are unable to meet the repayment and security requirements of the private sector. The proposed changes to the Farm Credit Act will provide the corporation with the authority to borrow some of its funds from the private financial markets. In this way FCC can more fully meet the needs of Canadian farmers even in a period of governmental budgetary restraint. This will also have the added advantage of giving the corporation a mechanism to react more quickly to major changes in the demand for farm credit. The corporation's limits on capital would also be increased from $150 million to $255 million. This would increase the corporation's borrowing capacity to $5.625 billion.

The long-term credit extended to farmers from all sources has risen from an estimated $655 million in 1975 to an estimated $2 billion in 1980 for an average annual growth rate of over 20% . Total requirements for 1981-82 are expected to reach $4.2 billion and are forecast to increase 14% a year.

Other changes are also being proposed to improve the level of service offered under the Farm Credit Act, for example, increasing the statutory loan limits available to farm enterprises. The loan limit requirements will also be moved from the Act to the Regulations, so that further changes can be made more easily as the need presents itself.

Another important change is the removal of the age limit of 35 for beginning-farmer loans under which borrowers can phase into farming during a 5-year period. These proposals have been under consideration for several years and have been widely supported by farmers, farm organizations, and elected representatives.

LOWER U.S. TARIFF ON HIGH QUALITY BEEF

Canadian beef exporters can now take advantage of a lower U.S. tariff rate for high quality 'portion control' beef cuts (beef already cut for individual servings). The tariff reduction to 4% from 10% was agreed upon in the Multilateral Trade Negotiations. However, Canadian exporters could not benefit from this lower rate until January 8, 1982, when the United States established regulations for the precise certification requirements for the new tariff item.

This improved access should increase Canada's ability to supply the large hotel, restaurant, and institutional trade in the United States. It also reduces the difference between Canadian and U.S. tariff rates on this high quality product.

To qualify for the lower tariff, Canadian exports from A2, A3, or A4 carcasses must be accompanied by a certificate issued by Agriculture Canada's Food Production and Inspection Branch. Sales of these 'portion control' beef cuts to the United States from all countries, including Canada, will be controlled under the U.S. Meat Import Law in years when trade restrictions under this law are in effect. There is currently no such restriction.

FARMBANK

FARMBANK is a computerized commodity data base maintained by Agriculture Canada's Marketing and Economics Branch. It contains approximately 1000 regional, national, and international food and agriculture data series for prices, production, stocks, consumption, imports, exports for all major grains and livestock products, as well as farm income statistics, retail prices, and general economic data.

FARMBANK data are mainly quarterly, and originate as far back as 1950. They are collected from Agriculture Canada and other Canadian, U.S., and international sources.

FARMBANK is now available on-line for a monthly fee from the Conference Board of Canada and Datacrown Inc. Prospective clients may contact their marketing representatives for more information about the data base and how to access this information.

The marketing representative for the Conference Board of Canada is Mrs. Viviane Paré; the address is 25 McArthur Ave., Vanier, Ontario, K1L 6R3. Datacrown Inc.'s representative is Mr. Jim Dunn; the mailing address is 770 Brookfield Road, Ottawa, Ontario, K1V 6J5.

Publications

The following 12 publications are available without charge from the Publications Manager, Regional Development and International Affairs Branch, Agriculture Canada, Ottawa, Ontario K1A 0C5.

Canada's Trade in Agricultural Products 1978, 1979, and 1980. G. Labrosse and E. McSorley. Publication No. 81/4. September 1981, 79 pp.

Economic Working Papers – Interprovincial Barriers to Trade in Ágricultural Products. Elmer L. Menzie, School of Agricultural Economics and Extension Education, University of Guelph, 43 pp.

Economic Working Papers – A Note on Supply Irreversibilities, Uncertainty and Comparative Advantage. Ralph Lattimore, 9 pp.

Economic Working Papers – A Profile of the Rabbit Meat Industry. Kathryn Shaver, September 1981, 40 pp.

Economic Working Papers – The "World Price" Impact of Multilateral Free Trade in Dairy Products. Ralph Lattimore and Stephanie Weedle, August 1981, 17 pp.

Food Market Commentary. Vol. 3, No. 4, December 1981, 47 pp.

Market Commentary – Animals and Animal Products. December 1981, 88 pp.

Market Commentary – Farm Inputs and Finance. December 1981, 65 pp.

Market Commentary – Grains and Oilseeds. December 1981, 52 pp.

Market Commentary – Horticulture and Special Crops. December 1981, 101 pp.

Market Commentary – Milk and Dairy Products. December 1981, 28 pp.

Market Commentary – Proceedings of the Canadian Agricultural Outlook Conference. December 1981, 70 pp.

The following five publications are available from: Publications, Department of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg, Manitoba R3T 2N2. (Cheques or money orders should be made payable to: Department of Agricultural Economics, University of Manitoba.)

An Examination of Production Efficiency in the Canadian Egg Industry: The Case of Ontario. R.M.A. Loyns and A.J. Begleiter, Research Bulletin 81-1, September 1981, 70 pp. ($4.00)

This study attempted to analyze changes in production efficiency in the Canadian egg industry since a national supply management program was introduced in 1973. The Ontario egg industry was examined since it was considered to be representative of the Canadian industry. Using a budget model, changes in Canadian production costs were compared before and after 1973, with cost changes in an area which was considered to be an efficient benchmark, San Diego County in California.

The results of the analysis suggest that Canadian egg producers have lost ground to their U.S. counterparts in terms of production efficiency. The distribution of farm sizes in the Canadian egg industry has remained relatively stable since 1973 as a result of maximum quota restrictions and the adequate returns available through the administered pricing formula. Consequently, the degree to which economies of scale are achieved has not improved visibly under supply management. In addition, the use of labor, investment, and miscellaneous inputs had increased in Canada relative to the competitive benchmark since 1973. The apparent decrease in relative efficiency of input use is not inconsistent with the theoretical effects of supply management, through pricing and quota regulations. It also suggests that part of the legislative requirements of the national egg marketing board is not being met.

Farm Management and Marketing for Agricultural Lenders. R.M.A. Loyns and T.L. Reynolds (eds.), papers presented to "An Introduction to Economic Farm Production for Lenders, 1981," Occasional Series No. 13, August 1981, 70 pp. ($6.00)

Farm Management and Marketing for Agricultural Lenders comprises eight papers related to farm management, originally presented at a one-week course for lenders at the University of Manitoba in May 1981. The papers were prepared by agricultural economists with a view to improving lenders' understanding of farm planning, budgeting, investment, and marketing. The particular audience for which the papers were prepared included senior lenders in the commercial banks and credit unions in Manitoba. However, the papers have been published and made available because they should appeal to a much wider audience interested in these topics as they relate to farm management. The list of papers is as follows:

L.B.B. Baker	A Detailed Farm Planning Approach
R.M. Josephson	Using Enterprise Budgets for Decision-Making
R.G. Aukes	Achieving and Maintaining Financial Control of the Farm Business
R. Ashmead	Assessing Farmers' Investment Options
D.F. Kraft	Ownership or Leasing of Farmland

P. Blawat	The Department of Agriculture as a Source of Farm Management Information for Farmers and Lenders
C.A. Carter	An Introduction to Futures Markets in Canada
R.M.A. Loyns	Farmers' Use of Forward Contracting and Futures Markets

Marketing and Marketing Strategies for Manitoba Farm Products. Extension Bulletin 81-1, R.M.A. Loyns, February 1981, 42 pp. ($2.00)

This paper was originally prepared for presentation to a farm lender workshop sponsored by the Faculty of Agriculture, University of Manitoba, in cooperation with the Credit Union Central of Manitoba, the chartered banks, and the Manitoba Department of Agriculture.

This paper develops some of the background material on marketing Manitoba agricultural products which is relevant to farmers' decision making and therefore relevant to farm financing decision makers. The paper first discusses marketing from the farmers' standpoint and establishes that good marketing is an important aspect of successful farm management. The next section provides a broad approach to the institutional and pricing side of Manitoba farm products. Following that, alternatives available for forward selling are discussed and a few simple examples of 'hedging' a commodity are presented. In addition, a list of the basic market information sources is attached.

The New Era in World Agricultural Trade: Perspectives for the Prairies and the Great Plains. E.W. Tyrchniewicz (ed.), proceedings of a seminar jointly sponsored by the Department of Agricultural Economics, Universities of Minnesota and Manitoba, in Winnipeg on November 13-15, 1979, Occasional Series No. 12, September 1980, 164 pp. ($4.00)

Participants in this seminar included farmers, government and business officials, and academics from both Canada and the United States.

The seminar explored several issues. Agricultural commodity exports after the Tokyo round were considered from the perspective of Canada, the United States, the EEC, Japan, and developing countries. Prospects for agricultural trade with China were discussed and the Canadian and U.S. grain marketing systems were compared. Uncertainties relating to fluctuations in exchange rates, labor disruptions, and Canada's ability to export one billion bushels of grain were also considered.

Financing Agriculture in the Next Decade. Proceedings of the Canadian Agricultural Economics Society (CAES) Workshop held at the University of Manitoba, Winnipeg, June 24-25, 1981, E.W. Tyrchniewicz (ed.), December 1981, 127 pp. ($5.00)

The 1981 CAES workshop theme of "Financing Agriculture in the Next Decade" addressed the changing structure of agriculture in Canada and the changing capital requirements coupled with the crushing effects of inflation. The workshop explored the implications of these issues for financing agriculture, especially from the standpoint of farm management information needs, tax and estate planning strategies, beginning farmers, and credit and land ownership policies. These proceedings provide a permanent record of the plenary session papers, formal remarks by the resource persons, and rapporteurs' summaries. The list of papers is as follows:

A. Gordon Ball	The Changing Structure of Agricultural Production in Canada: An Eastern Perspective
H.D. McRorie	Inflation and Agriculture
W.D. Jones and B.B. Perkins	Capital Requirements in Agriculture
Workshop (Chairman: J. McKenzie)	Implications for Farm Management Information Needs
Workshop (Chairman: Bruce Hackett)	Implications for Estate Planning
Workshop (Chairman: R.M. Josephson)	Implications for Beginning Farmers
Workshop (Chairman: D.F. Kraft)	Implications for Credit and Land Ownership Policies

Energy Management for Canadian Food and Beverage Industries. Publication No. 5143, Marketing and Economics Branch, 1981, 30 pp. *Available without charge from Communications Branch, Agriculture Canada, Ottawa, Ontario K1A 0C5.*

Impact of Rail Rationalization Proposals on the Net Income Position of the Grain Producer in Saskatchewan. Marion S. Fleming and Ihn H. Uhm, Report No. 10-81-02, August 1981, 45 pp. *Available from the Canadian Transport Commission, 15 Eddy, 1530, Ottawa (Hull) K1A 0N9.*

Ontario Farm Management Analysis Project 1980. Publication No. AEEE/81/11 July 1981, 14 pp. *Available without charge from the School of Agricultural Economics and Extension Education, University of Guelph, Guelph, Ontario N1G 2W1.*

IN REPLY TO AUTHORS AND EDITORS REGARDING VOL. 16, NO. 6, DECEMBER 1981
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